USER'S MANUAL

Crime Detection, Information and Tracking System (CDITS)

National University of Science and Technology
Military College of Signals
Lalkurti Rawalpindi

May, 2012

- ***Supervisors***
  - *Internal : Col Fahim Arif (HOD CSE Dept)*
  - *External: Maj Syed Muhammad Ayub Shah (MO Dte)*

- ***Project Group Members***
  - *Maj Saqib Khalid*
  - *Maj Saqib Rasheed*
  - *Maj Waseem*

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	5/30/00	User's Manual Template and Checklist
Rev. 1	4/10/02	Conversion to WORD 2000 format

User's Manual
Authorization Memorandum

I have carefully assessed the User's Manual for the (CDITS). This document has been completed in accordance with the requirements of the NUST System Development Methodology.

MANAGEMENT CERTIFICATION - Please check the appropriate statement.

_____ The document is accepted.

_____ The document is accepted pending the changes noted.

_____ The document is not accepted.

We fully accept the changes as needed improvements and authorize initiation of work to proceed. Based on our authority and judgment, the continued operation of this system is authorized.

_____ _____

Major Saqib Khalid May 2012
Project Leader

_____ _____

Major Agha Muhammad Ayoub May 2012
External Supervisor

_____ _____

Colonol Doctor Fahim Arif May 2012
Supervisor

USER'S MANUAL

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1.0 GENERAL INFORMATION

1.0.0 The crime rate is at increase due to numerous factors including increased population growth rate, unplanned expansions of the habitats and least capacity building vis modernization of the law enforcement agencies in Pakistan. The crime prevention is foremost in a healthy progressive society however, where it cannot be fully implemented, the short fall can be compensated through strong detection and investigation system to assist the process of justice. Automation of detection and tracking to facilitate speedy and fair investigations will help both the law enforcement agencies and judiciary to render speedy justice which is to a major part attributed to the paper based manual systems in vogue. These paper based proceedings are prone to malafiedy and tempering(s) with possible ulterior motives of the investigation agencies and their employees.

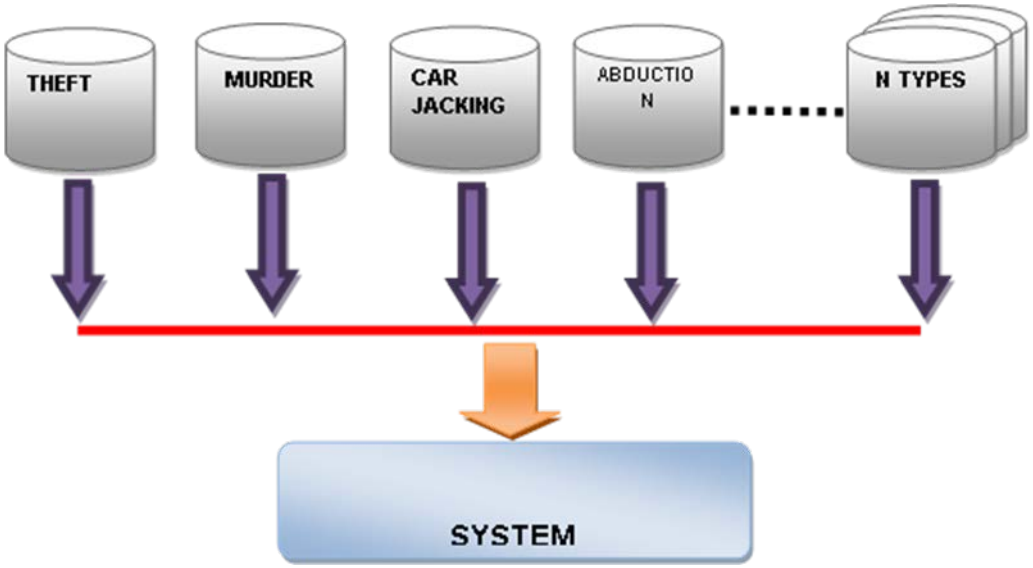


Figure 1.2: System overview

1.0.1 This system (Figure 1.2) will minimize and with furtherance will attain elimination of manual processes gradually and progressively by centralizing investigations and harmonizing tracking of criminals through across the board sharing and collaborations besides assisting the investigations through prompts for essentials details and required inputs. Once the system will be online, it will serve as a collaborative platform to render the services for effective crime prevention. Intended futuristic system is shown below:-

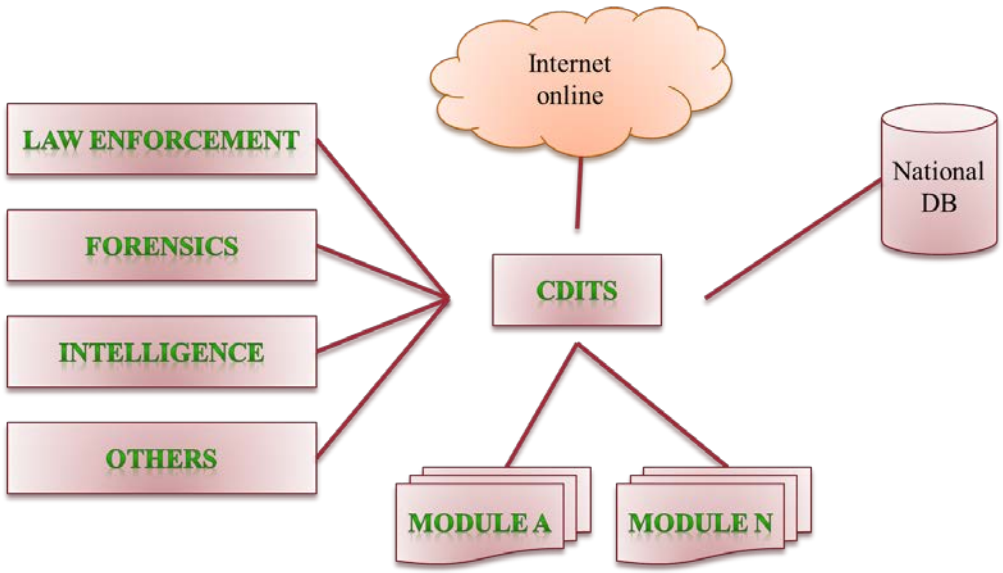


Figure 1.3: Big Picture

1.1 System Overview

1.1.0 Purpose. Ideal scenario followed by developed nations is of crime prevention, where social awareness plays a vital role in crime prevention. In third world or under developed nations like south and Southeast Asia and to include Pakistan crime prevention is not aimed at rather crime reduction and post crime damage control measures are undertaken. A furtherance towards the same and to put the prevalent practices in positive quarters improved crime detection and tracking can play a vital role. In crime ridden societies where no affective means are used and age old manual

whimsical procedures are in vogue, a new approach in detection, tracking and investigation may improve the scenario. Figure 1.1 below shows the states of crime prevention/detection/tracking with respect to different scenarios and their respective severities.

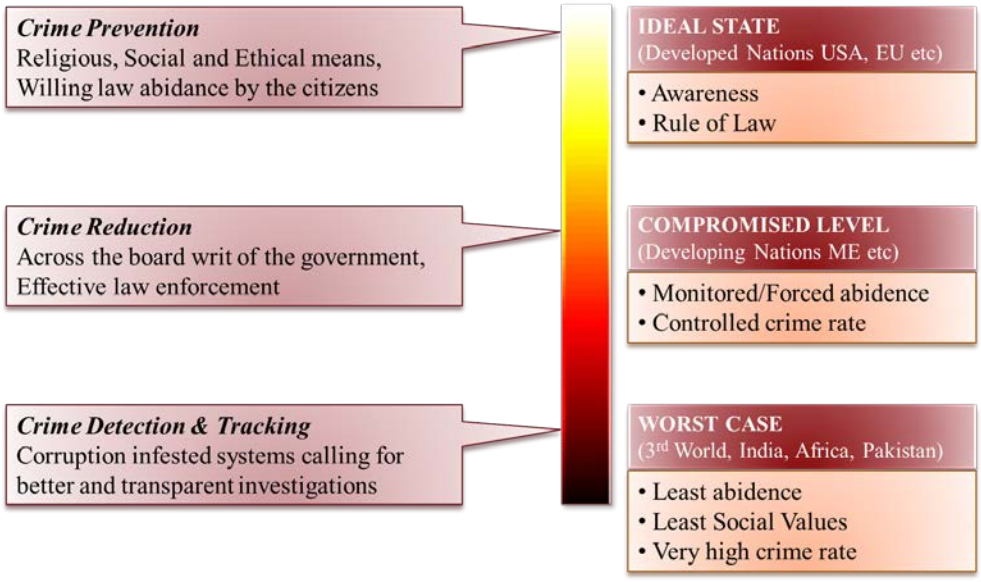


Figure 1.1: Crime Prevention, Reduction and Detection scenarios

1.1.1 CDITS is intended to be a national level crime investigation system encompassing the interaction of law enforcement / intelligence/ investigation agencies in collaboration with already existing databases of NADRA, PTA and cellular companies as shown in Figure 2.1(a, b).

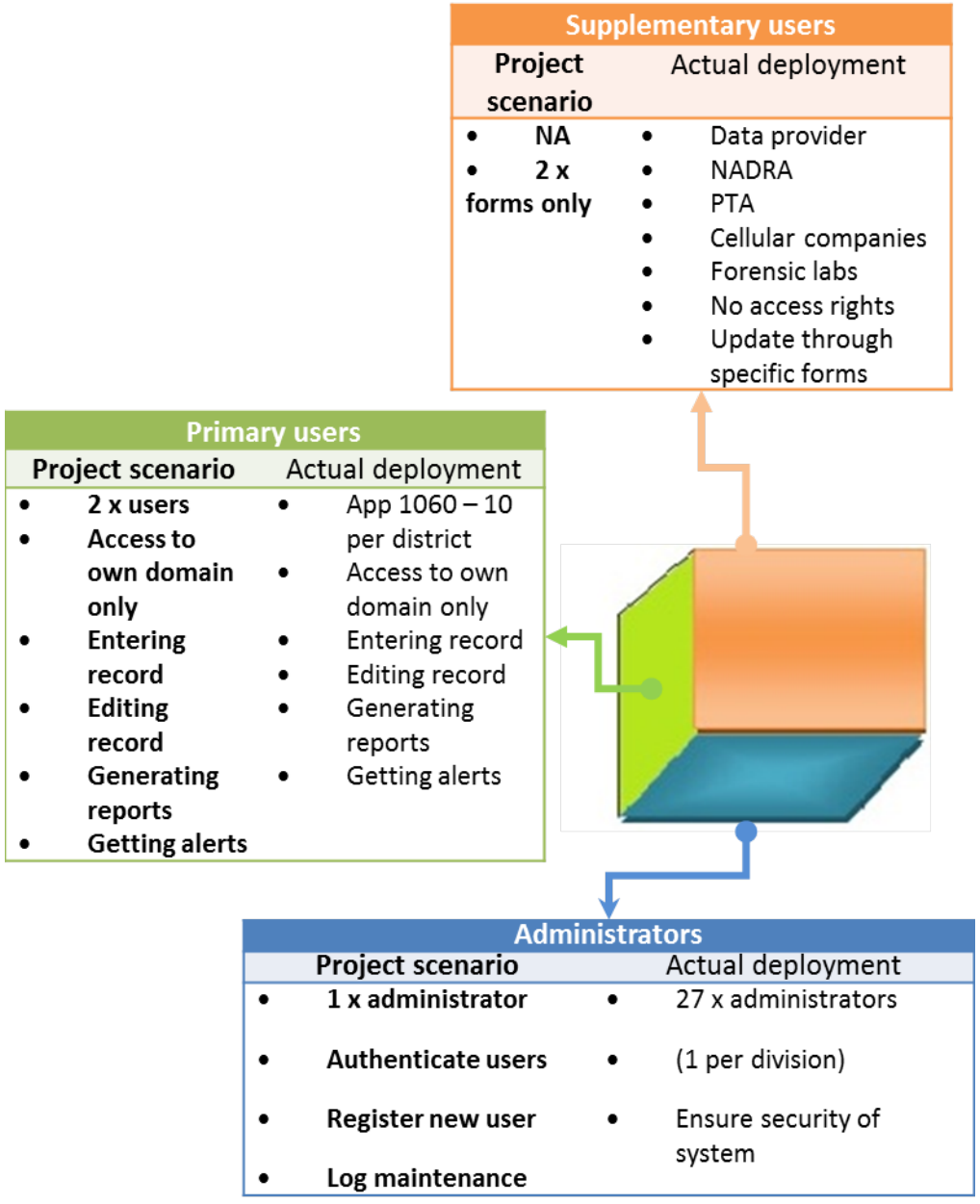


Figure 2.1(a): Posterior view

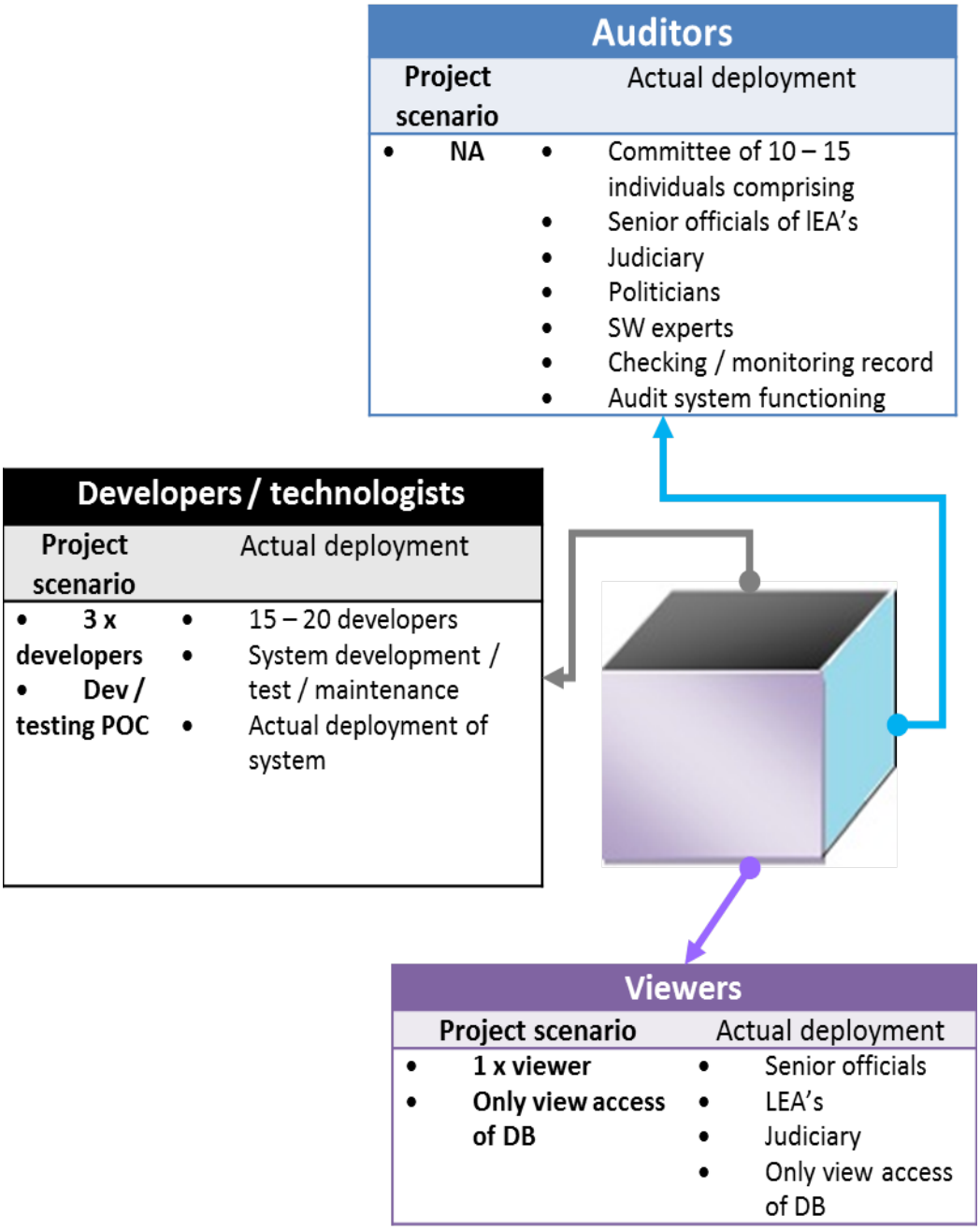


Figure 2.1(b): Anterior view

1.2 Project References

Ser	Name with Designation/Rank	Job Title	Remarks

1.3 Authorized Use Permission

This Software is made for FIA Pakistan only and the authority of its use is vested with DG FIA. No one is authorized to sale thereof software or a part of the software to anyone, in case of violation offender shall be punished under the laws covering national security risk crimes and copyright regulations.

1.4 Points of Contact

1.4.1 Information

Ser	Name	Appointment	Telephone	Cell
1.	Col Fahim Arif	HOD CSE Dept & Supervisor	051-1111111	0333-1234567
2.	Maj Muhammad Agha Ayoub	External Superviser	051-1111111	0333-1234567
3.	Maj Saqib Khalid	Team Lead	051-1111111	0333-1234567
4.	Maj Saqib Rashid	Team Member	051-1111111	0333-1234567
5.	Maj Waseem Ahmed	Team member	051-1111111	0333-1234567

1.4.2 Coordination

In case of any problems / errors during / after installation contact ser 3-5 as per 1.4.1.

1.4.3 Help Desk

Contact ser 3-5 of the 1.4.1 for the emergency assistance.

1.5 Organization of the Manual

Ser	Action	Search Options
1.	SignUp	How to login new user
2.	SignIn	Signin registered user
3.	Access Rights	
4.	Authentication Process	
5.	Report Incident	
6.	Investigative Process	
7.	View status of specific case using Case ID	
8.	System generated hypothesis	
9.	User generated hypothesis	
10.	Setting Hypothesis Weightage criterion	

11.	Add comments to a case	
12.	Filling Data	

1.6 Acronyms and Abbreviations

I.	**CDITS:**	Crime Detection Investigation and Tracking System
II.	**Detection:**	Refers to recognition of the actor (suspect(s)) depending upon the crime scene evidences, witnesses, leads formed by user defined hypothesis
III.	**Investigation:**	Parsing the investigation process in a progressive, systematic, procedural and automated mode
IV.	**Tracking:**	Tracking of investigative process, progressive acquisition of different related details and their inter relationships
V.	**FIA:**	Federal Investigation Agency
VI.	**SIB:**	Special Investigation Bureau
VII.	**IB:**	Intelligence bureau
VIII.	**ISI**:	Inter Services Intelligence
IX.	**MI:**	Military Intelligence
X.	**CID:**	Crime Investigation Department
XI.	**PTA:**	Pakistan Telecommunication Department
XII.	**LEAs:**	Law Enforcement Agencies
XIII.	**DB:**	Data Base
XIV.	**MIS:**	Management Information System
XV.	**Cfm:**	Confirm
XVI.	**TBD:**	To be determined
XVII.	**Fig**	Figure

2.0 SYSTEM SUMMARY

2.0 SYSTEM SUMMARY

2.0.0 System allows user to sign in and signup.
2.0.1 Sends Requests for the signup to the administrator for authentication.
2.0.2 Sign in Legtimate users from the server as per the access policy.
2.0.3 Allows the users to fill in the required information.
2.0.4 Correct wrong information filled.
2.0.5 View status of some case.
2.0.6 View Progress of some case.
2.0.7 Gives warnings to the users for unfilled or incomplete information.
2.0.8 Allows users to enter a manual hypothesis.
2.0.9 Generates a hypothesis to assist investigative process.
2.0.10 Sets weightage criterion.
2.0.11 Generates results to indicate possible suspects or criminal(s).
2.0.12 Take print of the generated reports.
2.0.13 Search results using CNIC or case ID etc.

2.1 System Configuration

2.1.0 Windows XP / Windows Vista / Windows 7
2.1.1 System installed with CDITS client must be connected to the CDITS server.
2.1.2 Installation
- 2.1.2.0 Server Installation — Database and software will be deployed on the server.
- 2.1.2.1 Client Installation — Remotely connected client machines can only access.

2.2 Data Flows

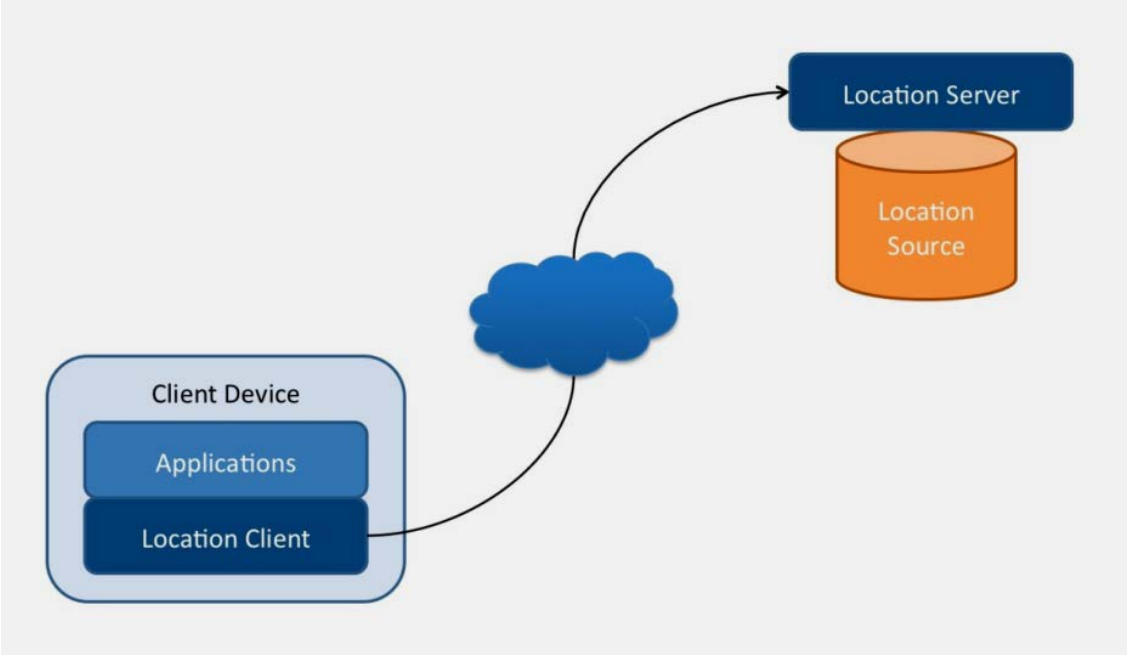


Fig (2.2.0) Level - 0 of CDITS

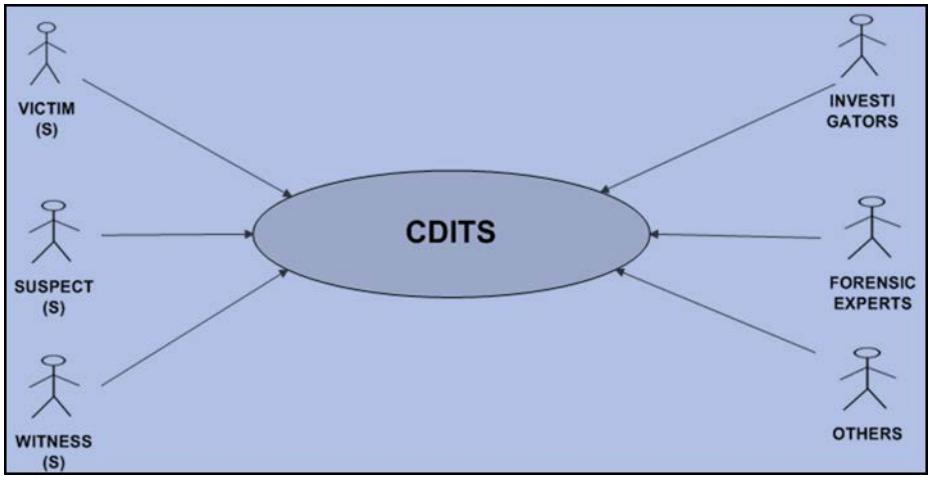


Fig (2.2.0) Level - 1 of CDITS

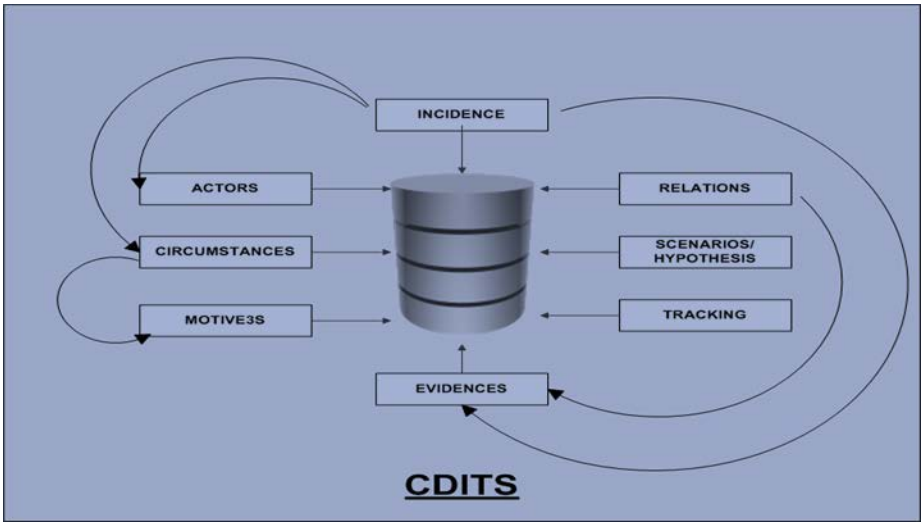


Fig (2.2.0) Level - 2 of CDITS

2.3 User Access Levels

Ser	User Category	Access Policy	Remarks
1.	Administrator	Access all feature of the System including • Authenticating users • Setting the user access levels • Update the system • Search • Can freeze any user account with documentary proof of reason's for which the account is being freezed.	
2.	Investigator	• Signup and signin • Generate case ID • Repot the Incident • Fill in initial information • Generate hypothesis • Seek results • Add Comments • Search • Take print	Used by the Police or other departments to whom the matter was first reported and are carryng out the investigations of the case
3.	Forensic Experts	• Signup and signin • Fill in concerned information • Add Comments • Search • View • Take print	
4.	Victim / Witness / Suspect	• Signup and signin • Search • View • Take print	
5.	Others	• Signup by adding comments why a login is required • Signin if authenticated by the administrator and use the system features as per the access rights granted by the administrator.	Anyone who is pushed into the investigations as per the reuirement

3.0 GETTING STARTED

3.0 GETTING STARTED

This Section allows user to handle any issues regarding use of the software and any trouble shoots for the user.

3.1 Logging On

3.1.1 Login Registered User

Fig ----

Fig ----

On CDITS home page shown in fig--- registered user selects login from the menu bar and a login window appears that gives an option to insert the user name and the password. After inserting the required data user selects Login button the system will login the registered user otherwise generates error.

3.1.2 Sign Up

Fig ----

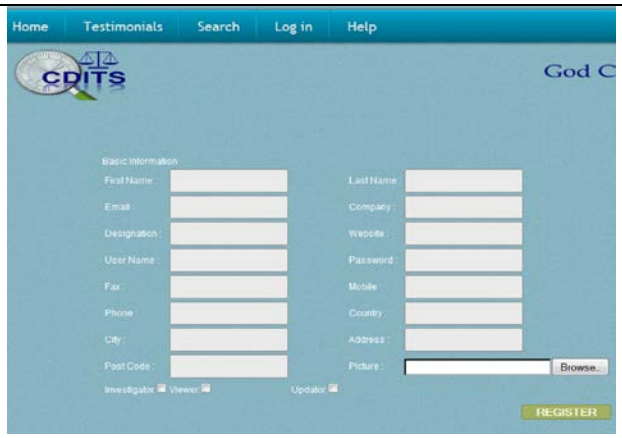


Fig ----

On CDITS home page shown in fig--- registered user selects login from the menu bar and a login window appears that gives an option to signup. After selecting signup a signup form appears showing different columns to be filled in by the user and on successful completion user selects register than the account rquest is sent to the administrator for verification. After verification the use rcan login using steps given in in 3.1.1.

3.1.3 Access Rights Access rights are granted to the users by administrator manually depending upon the type user as per table in 2.3.

3.2 Changing User ID and Password.

Once a username is created cannot be changed but password can be changed.

3.4 Exit System.

For exit from the system user has to first log off the system and than select the close button of the browser to close the window**.**

CHAPTER: 1

Introduction and Background

1.1. Introduction and background

Ideal scenario followed by developed nations is of crime prevention, where social awareness plays a vital role in crime prevention. In third world or under developed nations like south and Southeast Asia and to include Pakistan crime prevention is not aimed at rather crime reduction and post crime damage control measures are undertaken. A furtherance towards the same and to put the prevalent practices in positive quarters improved crime detection and tracking can play a vital role. In crime ridden societies where no affective means are used and age old manual whimsical procedures are in vogue, a new approach in detection, tracking and investigation may improve the scenario. Figure 1.1 below shows the states of crime prevention/detection/tracking with respect to different scenarios and their respective severities.

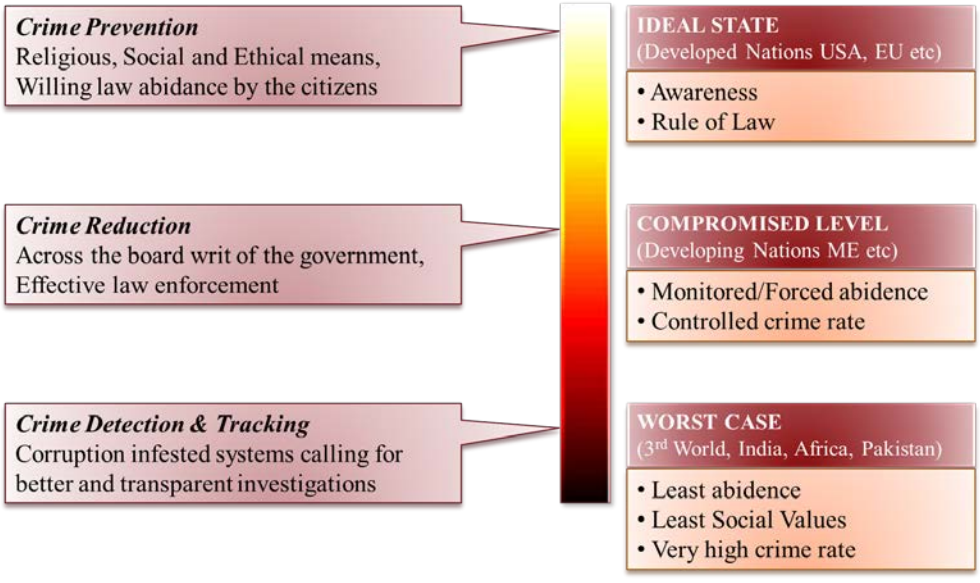


Figure 1.1: Crime Prevention, Reduction and Detection scenarios

1.2. The crime rate is at increase due to numerous factors including increased population growth rate, unplanned expansions of the habitats and least capacity building vis modernization of the law enforcement agencies in Pakistan. The crime prevention is foremost in a healthy progressive society however, where it cannot be fully implemented, the short fall can be compensated through strong detection and investigation system to assist the process of justice. Automation of detection and tracking to facilitate speedy and fair investigations will help both the law enforcement agencies and judiciary to render speedy justice which is to a major part attributed to the paper based manual systems in vogue. These paper based proceedings are prone to malafiedy and tempering(s) with possible ulterior motives of the investigation agencies and their employees.

Figure 1.2: System overview

1.3. Problem Addressed

This system (Figure 1.2) will minimize and with furtherance will attain elimination of manual processes gradually and progressively by centralizing investigations and harmonizing tracking of criminals through across the board sharing and collaborations besides assisting the investigations through prompts for essentials details and required inputs. Once the system will be online, it will serve as a collaborative platform to render the services for effective crime prevention. Intended futuristic system is shown below:-

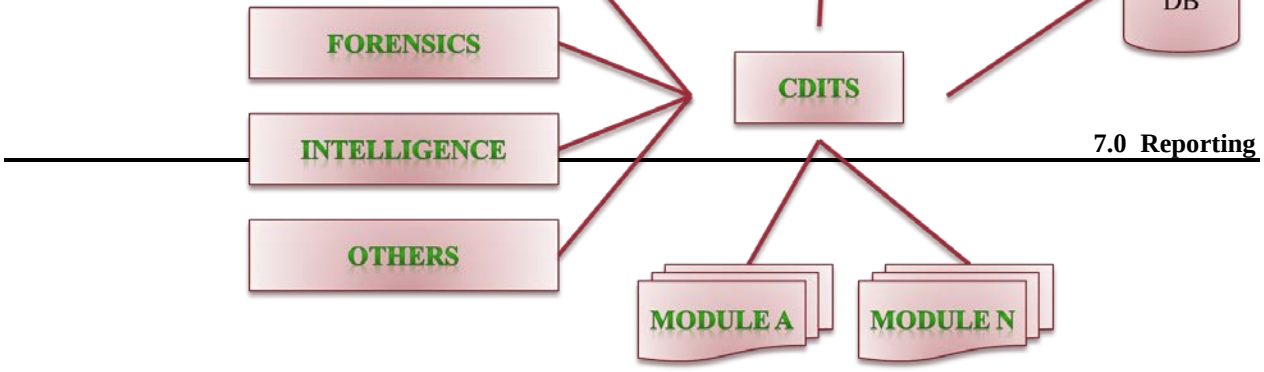


Figure 1.3: Big Picture

1.4. Goals And Objectives

The project encompasses building a complete set of databases specific to crimes, will acquire data of criminals, suspected actor and his/her accomplices, will acquire essential data from the relevant stakeholders and will walk through the investigation process incorporating both traditional and modern approaches with centricity resting at national level. Comparison between existing system and under development CDITS is as below:-

Existing Procedures	CDITS procedures
Manual procedures	Automated procedures
Blind, whimsical and corrupt heuristics	Transparent, tractable and auditable system
Random investigations procedures	Progressive, systematic investigating procedures
Lucrative data keeping	Formal authentic record keeping
Orthodox investigative conventions	Technology driven system

Table 1.1 Comparison between existing methods and proposed processes.

Domain and technical perspective of scope are as under:-

1.4.1 **Domain Perspective:** This system is a concept criminal investigation that will encompass:

1.4.1.1 Automation of existing manual processes

1.4.1.2 Transparity / visibility, traceability & accountability of the heuristic manual processes being practiced at present

1.4.1.3 Development of a procedural approach and a well-defined process

1.4.1.4 Possibility of objective and systematic collaboration and information sharing amongst investigation / law enforcement agencies

1.4.2 **Technical Perspective** System will comprise of a relational database containing details of:

1.4.2.1 Incidence (crime)

1.4.2.2 Actors (victim(s), suspect(s), witnesses)

1.4.2.3 Evidences (forensics, documents, articles)

1.4.2.4 Relation between entities – Investigative process/ hypothesizing scenarios

1.4.2.5 A user friendly front end & user accepted interface

1.4.3 **Temporal Perspective**

1.4.3.1 A POC – ab-initio development of a hitherto nonexistent process

1.4.3.2 A system calling for must fill in detail

1.4.3.3 Progressive compilation of data, assisting formulation of hypothesis

1.4.3.4 Establishing linkages towards ascertaining leads – providing interface for forming hypothesis by the user

1.4.3.5 Auto tracking of investigative process

1.5. **Academic Objectives:** This project involves following core areas of Software Engineering:

1.5.1 Architecture, Design and Implementation of Information and information Management Systems.

1.5.2 Knowledge Management.

1.5.3 Relational Data Bases.

1.5.4 Requirement Engineering, System Architecture, Design and Implementation Methodologies and Processes.

1.5.5 Human Networks.

1.5.6 Human Computer Interaction.

1.5.7 Ergonomics.

1.5.8 Artificial Intelligence.

1.6. Deliverables

Following deliverables have been prepared:

1.6.1. **Product/System**

1.6.1.1. **Working Software**

1.6.1.2. **Proof of Concept**

1.6.1.3. **Test Cases**

1.6.2. **Reports**

1.6.2.1. **Requirements – Elicitation/Analysis**

1.6.2.2. **Design- Sys Architecture, Use Case diagram, sequence diagram, class diagram**

1.6.2.3. **Implementation- Code**

1.6.2.4. **Test Cases**

1.6.3. User Manual

CHAPTER: 2

Literature Review/Research

2.1. Research Methodology

2.1.1. **Interviews.** Interviews with different law enforcement persons were conducted to ascertain the scope and procedures in vogue.

2.1.2. **Discussions.** Discussions were done with law enforcement officials to have their input in the perceived system.

2.1.3. **Criminology Study.** Internet was used to study different criminology terms and to get an insight of the crime investigation.

Links are mentioned in references section.

2.2. Business Need

In third world countries like Pakistan crime is not prevented rather, best that can be done is detection and tracking of crimes for future prevention. Hence, at present Pakistan falls in the worst category (Fig 1.1). Important aspects of Law enforcement in our country at present are:

2.2.1. No systematic investigation system either exists or is followed, even in manual procedures at present in the country.

2.2.2. Faulty and week investigations are the root cause of defective judicial system (either intentional or unintentional)

2.2.3. The perceived system has equal applicability to the new world and third world's fight against crimes and criminal brigands – non state actors / terrorists

2.2.4. Deployment of CDITS will ensure eradication of the basic roots of corruption from our law enforcement system through:

2.2.4.1 A formal authentic record; unthought-of hitherto

2.2.4.2 Effective report generations on demand

2.2.4.3 Facilitating the overall process of investigation with regards to the current dimensions of technology

2.3. CDITS Perspective

CDITS is intended to be a national level crime investigation system encompassing the interaction of law enforcement / intelligence/ investigation agencies in collaboration with already existing databases of NADRA, PTA and cellular companies as shown in Figure 2.1(a, b).

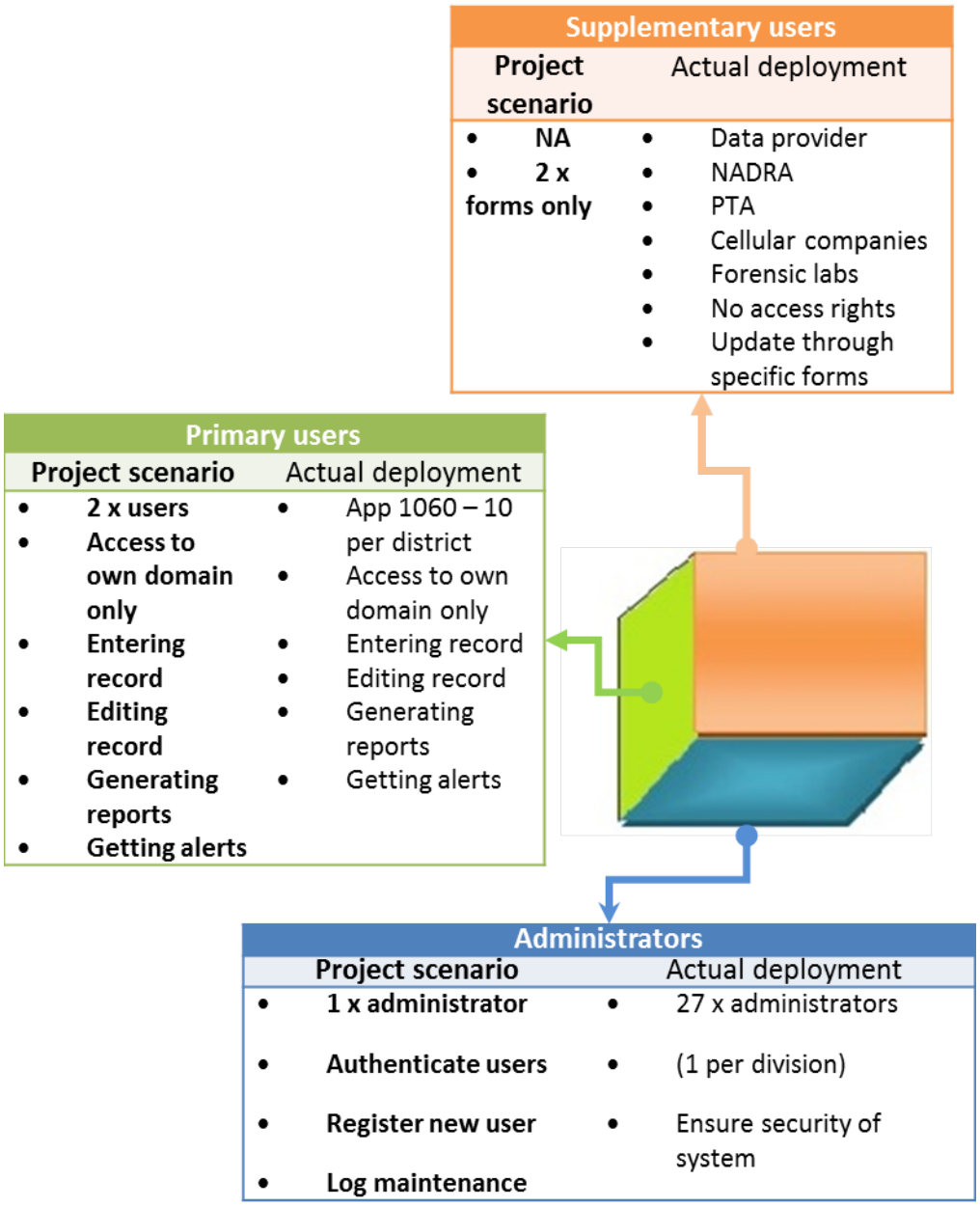


Figure 2.1(a): Posterior view

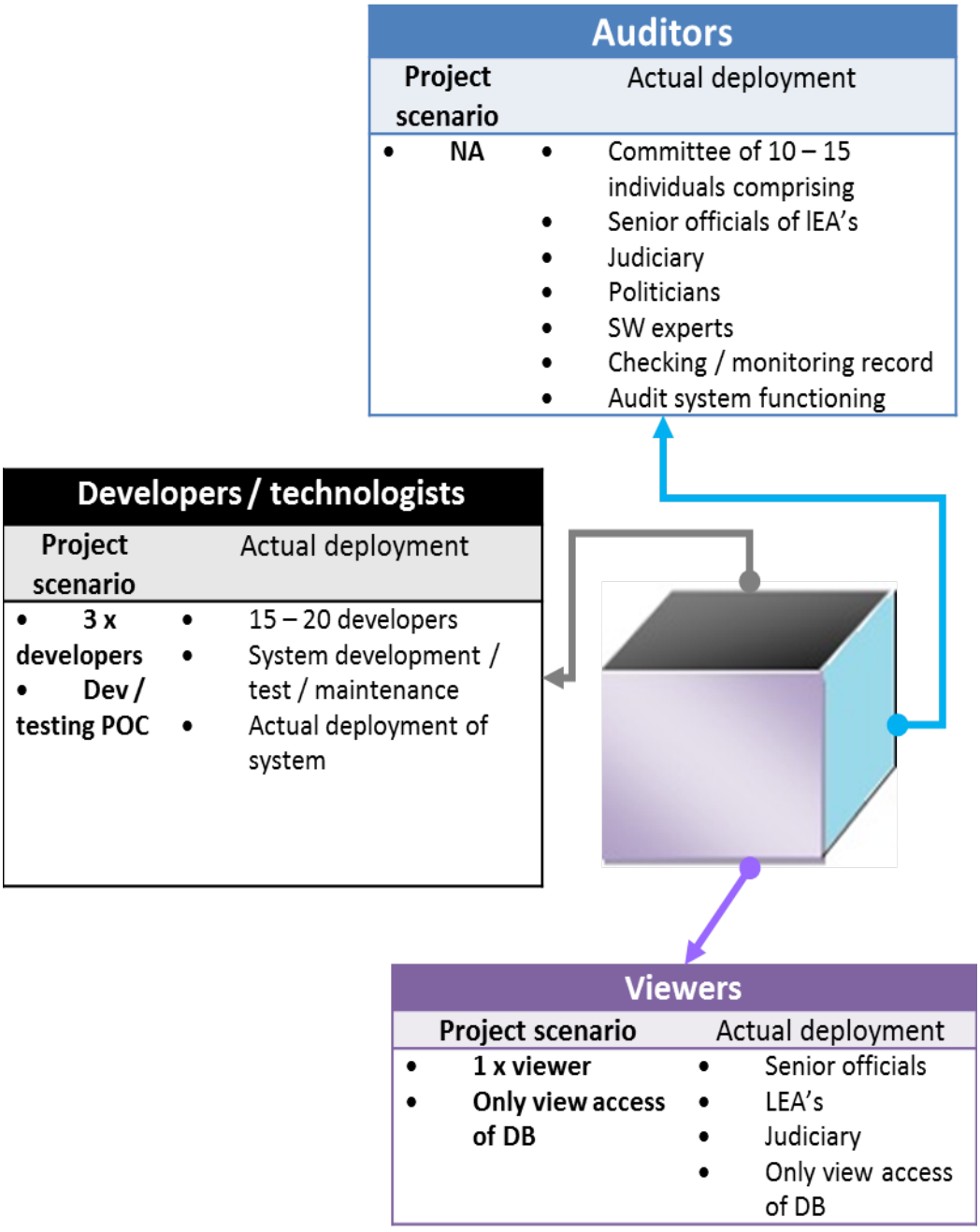


Figure 2.1(b): Anterior view

2.4. CDITS Functions:

The system would be a complete MIS with defined / standardized fields calling for essential details must to be filled in and establishing

linkages towards ascertaining leads i.e. Providing interface for forming hypothesis by the user. General flow of investigation process is shown below:-

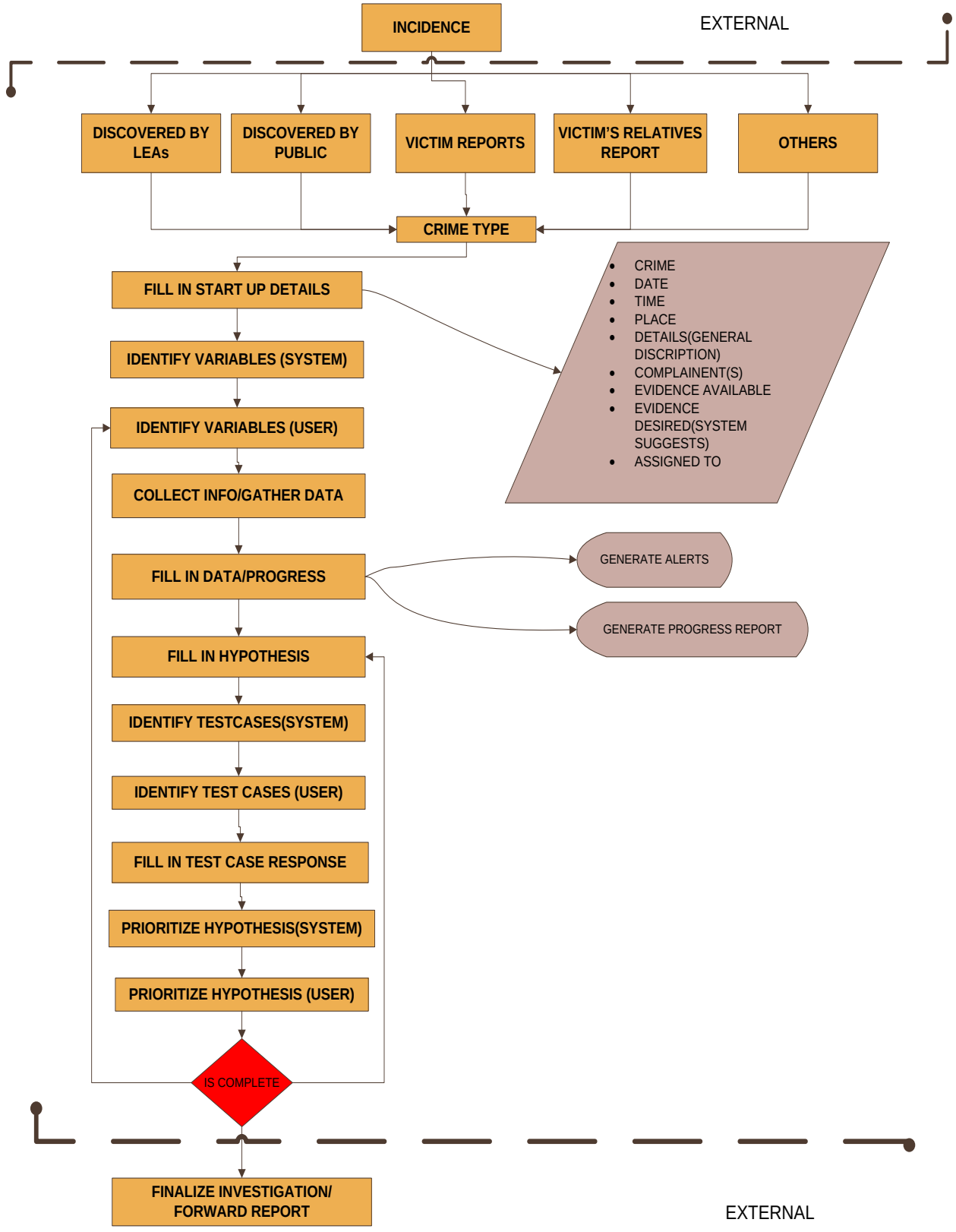


Figure 2.2: System functions

CHAPTER: 3

Software Requirements Specification

3.1. User Classes and Characteristics:

User classes differentiated on the basis of frequency of use, security or privilege levels are as under:

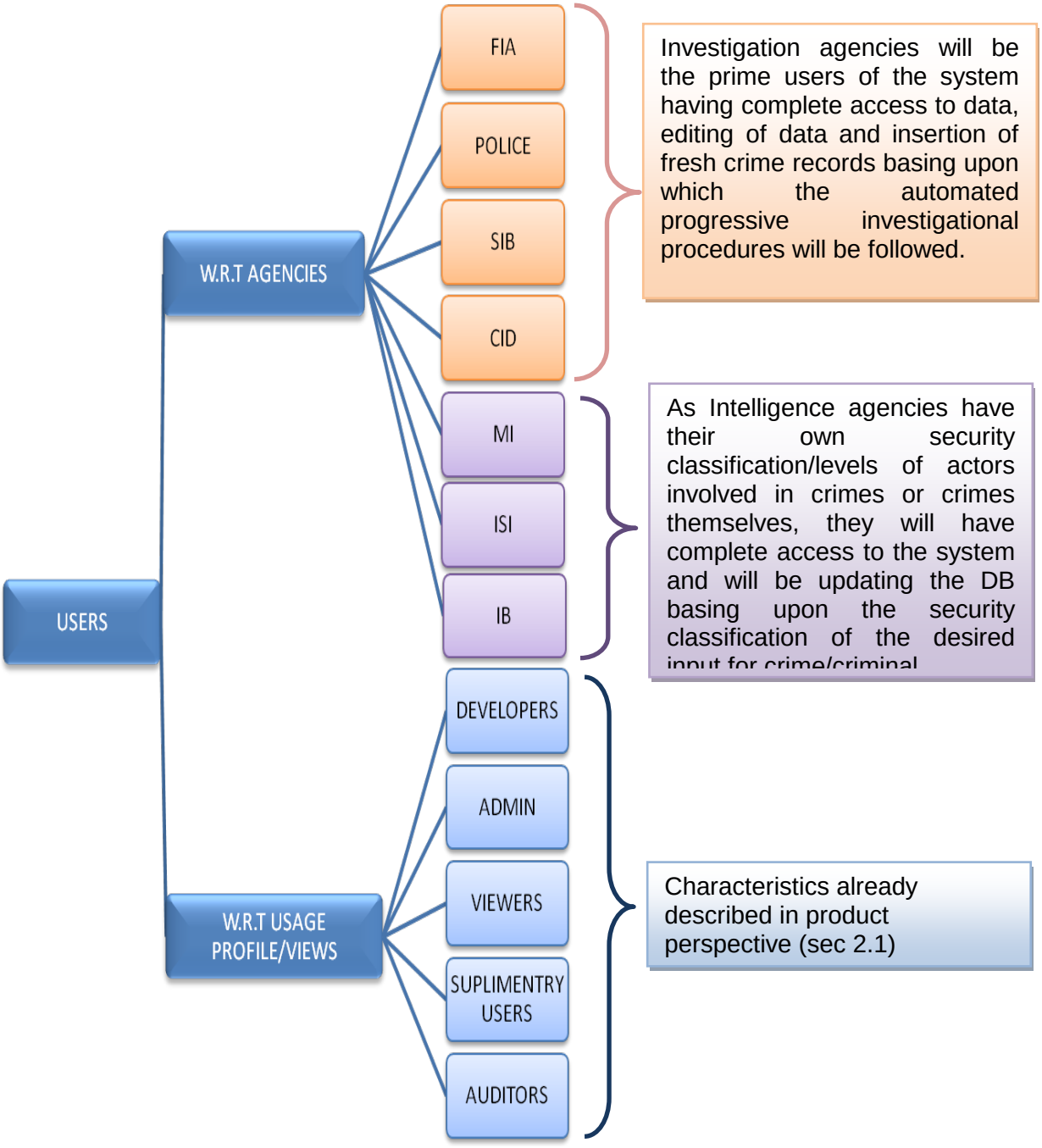


Figure 2.5: User classes and characteristics

3.2. System Features/Functional Requirements:

Major functions/features provided by the system are shown in flow chart Figure 2.2.

3.2.1 Start (Sign up / Sign in)

3.2.1.1 **Description and Priority**: User will be prompted to sign in before entering into the system. Sign in will be through unique user ID and password. New User will be required to sign up through filling in a form, that will fetch necessary details from user and his request will be sent to administrator. On verification he will be issued a unique ID and password.

3.2.1.2 **Stimulus/Response Sequences** For sign in, response sequence will be as under:

3.2.1.2.1 Click on sign in button

3.2.1.2.2 Enter ID and password

3.2.1.2.3 Password checking by the system

3.2.1.2.4 User access to the system

3.2.1.2.5 For sign up response sequence will be as under.

3.2.1.2.6 User click on sign up button

3.2.1.2.7 Sign up form will appear

3.2.1.2.8 Filling in of form by user

3.2.1.2.9 Submitting the form through submit button

3.2.1.2.10 Administrator will verify credentials (manually) and assign unique Id and password to the user.

3.2.1.3 **Functional Requirements**:

3.2.1.3.1 **Record of User ID and Password**:

Record of all the user Id's and password will be maintained in server. Checking of passwords will also be through server.

3.2.1.3.2 **Alerts for wrong passwords and ID:** System should generate alerts for wrong password and ID. Three consecutive wrong attempts by any user should block that particular user till confirmation by administrator.

3.2.2 Hypothesis Generation/Validation

3.2.2.1 **Description and Priority:** After filing in of variables system will prompt user to generate likely hypothesis, this will be filled in manually by the investigator. After filling in variables user will generate test cases, system will prompt user to fill in test cases for each hypothesis and grade each hypothesis as yes/no/maybe. At the end system will calculate probability of correctness of hypothesis.

3.2.2.2 Stimulus/Response Sequences

3.2.2.2.1 Prompt user to fill in n number of hypothesis basing on the variables

3.2.2.2.2 Write test cases for each hypothesis

3.2.2.2.3 Grade each hypothesis as yes/no/maybe

3.2.2.2.4 Formulation of result i.e. calculation of probability of correctness of each hypothesis

3.2.2.2.5 Storing record in DB

3.2.2.3 **Functional Requirements**

3.2.2.3.1 **Interface to fill in Hypothesis and test cases**: Interface in the form of text boxes will be made to allow user to fill in details as shown in the user interface section

3.2.2.3.2 **Formulation of result**: Result will be formulated on the basis of grading of test cases for hypothesis. For example if a hypothesis has four test cases and all the test cases have grading " yes", then probability of correctness of hypothesis will be 1 i.e. maximum/highest.

3.2.3 **Editing Record**

3.2.3.1 **Description and Priority:** User will be allowed to edit record of any case that has been finalized, but edit feature will only be applicable for particular fields only. Following entries will not be editable.

3.2.3.1.1 Basic information of witnesses/ suspect/ victim

3.2.3.1.2 New Variables can be added but previously committed variables will not be edited

3.2.3.1.3 New Hypothesis can be generated but previously committed hypothesis will not be edited

3.2.3.1.4 Finalized investigations will not be edited

3.2.3.2 Stimulus/Response Sequences

3.2.3.2.1 On clicking the edit button, a window containing fields that can be edited will appear

3.2.3.2.2 User will enter case ID and select record to be committed

3.2.3.2.3 System will check authentication of user to allow editing

3.2.3.2.4 Previous record of editing entity will be fetched from DB and displayed

3.2.3.2.5 User will edit record

3.2.3.2.6 Edited record will be placed in DB

3.2.3.3 Functional Requirements

3.2.3.3.1 **Authenticating user**: User will be authenticated for editing basing on his rights that will be defined by administrator during sign up.

3.2.3.3.2 **Defining Entities to be edited**: Entities that can be committed will be properly defined and entities that are forbidden will be marked in red color

3.2.3.3.3 **Refreshing DB**: After editing Database will be refreshed, but to curb any forgery, previous version of

the case will also be kept in record as previous version

3.2.4 Report generation

3.2.4.1 **Description and Priority:** User will be allowed to get summary or print of reports. Following reports will be generated.

3.2.4.1.1 Case summary using case ID

3.2.4.1.2 Record of criminal, based on name, CNIC and case ID

3.2.4.1.3 Record of crimes in a particular location

3.2.4.1.4 Record of crimes basing on timeline

3.2.4.2 **Stimulus/Response Sequences**

3.2.4.2.1 On pressing report button a new window will pop up, showing types of reports that can be generated

3.2.4.2.2 User will select type of report and fill in necessary entries like time duration for report generation according to time line

3.2.4.2.3 Summary of requested report will be shown and option to print will be given basing on the security classification of report and rights of user

3.2.4.3 **Functional Requirements**

3.2.4.3.1 **Searching of DB**: DB will be searched for generation of report, algorithms to implement search will have to be devised.

3.2.4.3.1 **Printing Option**: User should be able to print report, if required.

3.2.4.3.1 **Authentication of user**: Before generating report, user will be authenticated against rights

3.2.5 Search

3.2.5.1 **Description and Priority:** Search will be based on following criteria.

3.2.5.1.1 CNIC

3.2.5.1.1 Case ID

3.2.5.1.1 Name

3.2.5.2 **Stimulus/Response Sequences**

3.2.5.2.1 User will select the search option

3.2.5.2.2 DB will be searched

3.2.5.2.3 Result displayed in a new window

3.2.5.3 **Functional Requirement**

3.2.5.3.1 **Searching of DB**: DB will be searched, algorithms to implement search will be devised.

3.2.6 Alerts

3.2.6.1 **Description and Priority:** Alerts will be generated for following actions/situations.

3.2.6.1.1 Wrong password/ID

3.2.6.1.2 Entering wrong parameter i.e. character in place of integer

3.2.6.1.3 Missing must fill in details

3.2.6.1.4 Accessing data, of which user does not have rights.

3.2.6.2 **Stimulus/Response Sequences:** On any above mentioned illegal action alert will be generated showing type of illegal action and suggestions to correct it.

3.2.6.3 **Functional Requirements:** Verification of entities for alert generation: Entity being filled will be checked when user commits or selects wrong option

3.2.7 Low level intelligence

3.2.7.1 **Description and Priority:** It is desirable to introduce low level intelligence in the system at this moment. During future expansion of the system, it can be made fully intelligent by adding new modules. In present system following

intelligence features will be inculcated in the system

3.2.7.1.1 Using fuzzy systems to calculate the suspects probability

4.0 3.3 NONFUNCTIONAL REQUIREMENTS

5.0 3.3.1 **PERFORMANCE REQUIREMENTS:** RESPONSE TIME OF THE CDITS SHOULD BE LESS THAN 5 SECONDS MOST OF THE TIME. RESPONSE TIME REFERS TO THE WAITING TIME WHILE THE SYSTEM ACCESSES, QUERIES AND RETRIEVES THE INFORMATION FROM THE DATABASE. THE SYSTEM SHALL SHOW NO VISIBLE DETERIORATION IN RESPONSE TIME AS THE NUMBER OF USERS OR DATA INCREASES.

6.0 3.3.2 **SAFETY REQUIREMENTS:** FOR SAFETY DATA WOULD BE SAVED IN INDIVIDUAL COMPUTERS AND AT THE SAME TIME A BACKUP COPY WILL BE SAVED WITH THE BRANCH SERVER AND SERVER AT MAIN HQ TO SAVE DATA FROM LOSS.

7.0 3.3.3 **USER AUTHENTICATION:** USER WILL BE AUTHENTICATED ON THE BASIS OF ID AND PASSWORD. COMPLETE SECURITY OF SYSTEM WILL BE IMPLEMENTED AS SEPARATE PROJECT

8.0 3.3.4 SOFTWARE QUALITY ATTRIBUTES

3.3.4.1 **Flexibility:** Since this system is a sub part of bigger picture so flexibility is most essential and

desired feature so that new modules can be configure red easily

3.3.4.2 **Simplicity**: Following are the desired features ensuring aspect of simplicity

3.3.4.1 Closer to real world

3.3.4.1 User friendly interface

3.3.4.1 Minimal training required

3.3.5 **Reliability:** CDITS should be available 24 hours a day, 7 days a week and shall always provide real time information. The system shall be robust enough to have a high degree of fault tolerance. For example, in case of invalid inputs, the system should not crash and shall identify the invalid input and produce a suitable error message i.e. exception handling. System should be able to recover from hardware failures, power failures and other natural catastrophes and rollback the databases to their most recent valid state.

3.3.6 **Usability:** System should provide easy-to-use graphical user interface. The web interface should be intuitive and easily navigable. Users should be able to understand the menu and options provided. Any notification or error messages generated by the system should be clear, concise, polite and free of jargon.

3.3.7 **Integrity:** Only system administrator should have the right to change system parameters, such as access rights etc. Users need to be authenticated before having access to any confidential data.

3.3.8 **Portability**: The CDITS is perceived to be flexible system able to run on different web platform i.e. explorers

CHAPTER: 4

System Design Specifications

4.1. Design Methodology.

Design methodology being used by us to develop CDITS is **AGILE** Methodology because of following reasons:

Agile development methodology attempts to provide many opportunities to assess the direction of a project throughout the development lifecycle. This is achieved through regular cadences of work, known as sprints or iterations, at the end of which teams presents a shippable increment of work. Thus by focusing on the repetition of abbreviated work cycles as

well as the functional product they yield, agile methodology is described as ***"iterative***" and ***"incremental***."

The results of this "inspect-and-adapt" approach to development greatly reduce both development costs and time to market. Because teams can gather requirements at the same time they're gathering requirements, the phenomenon known as "analysis paralysis" can't really impede a team from making progress.

It is helping us to build the right product instead of committing to market a piece of software that hasn't even been written yet, agile empowers us to optimize release of CDITS as it is developed.

4.2 **Architectural Pattern:** Architectural Pattern being used by us to develop CDITS is Client Server because of following reasons:

Straightforward distribution of data. For web based applications it is best suited as highest degree of data distribution can be achieved using client server.

Transparency of location. User has liberty to access and modify CDITs as per the usage rights, irrespective of location constraints.

Mix and match heterogeneous platforms. Freedom to use any platform to access CDITs.

Easy to add new servers or upgrade existing servers.

Scalability is a major constraint for CDITs and addition of new servers an easily be added using client server architecture.

Availability. CDITs is a web based application and can easily be made available 24/7 using multiple servers so that CDITs is up all the time even during hours of maintenance, some server failure etc.

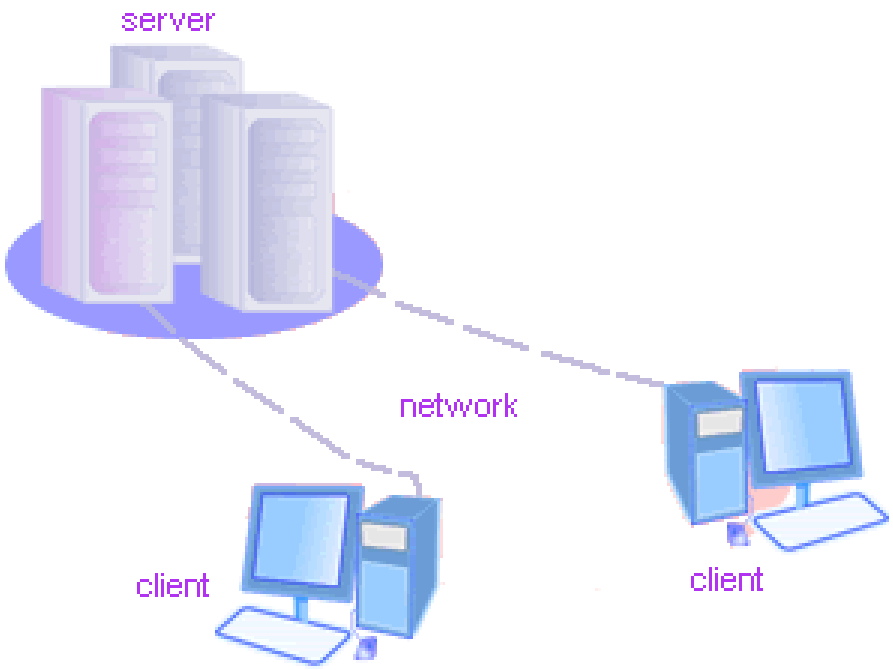


Fig-4.1 Client Server Architecture

4.3. Content Modeling

4.3.1. **Use case diagram:** Use case diagram describe the business functionality of system. For better understanding use case diagram is illustrated from perspective of users of CDITS (Users and characteristics described in SRS document – page number 11)

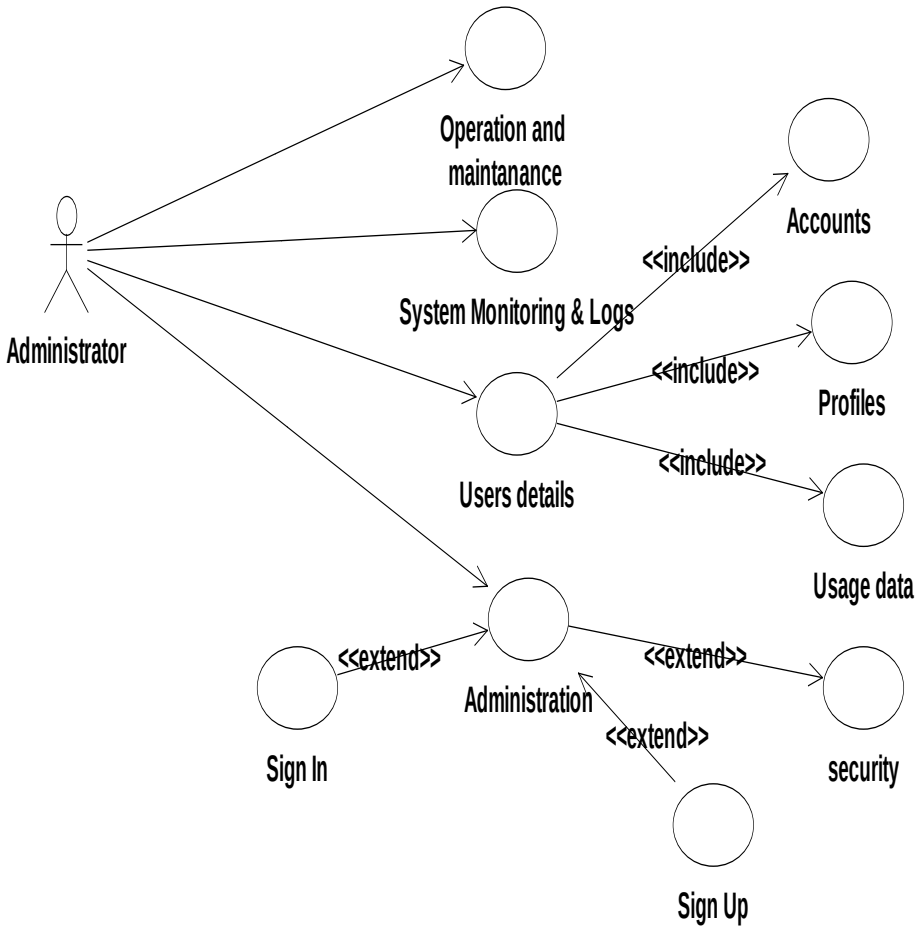


Fig 4.2 Use case (Administrator View)

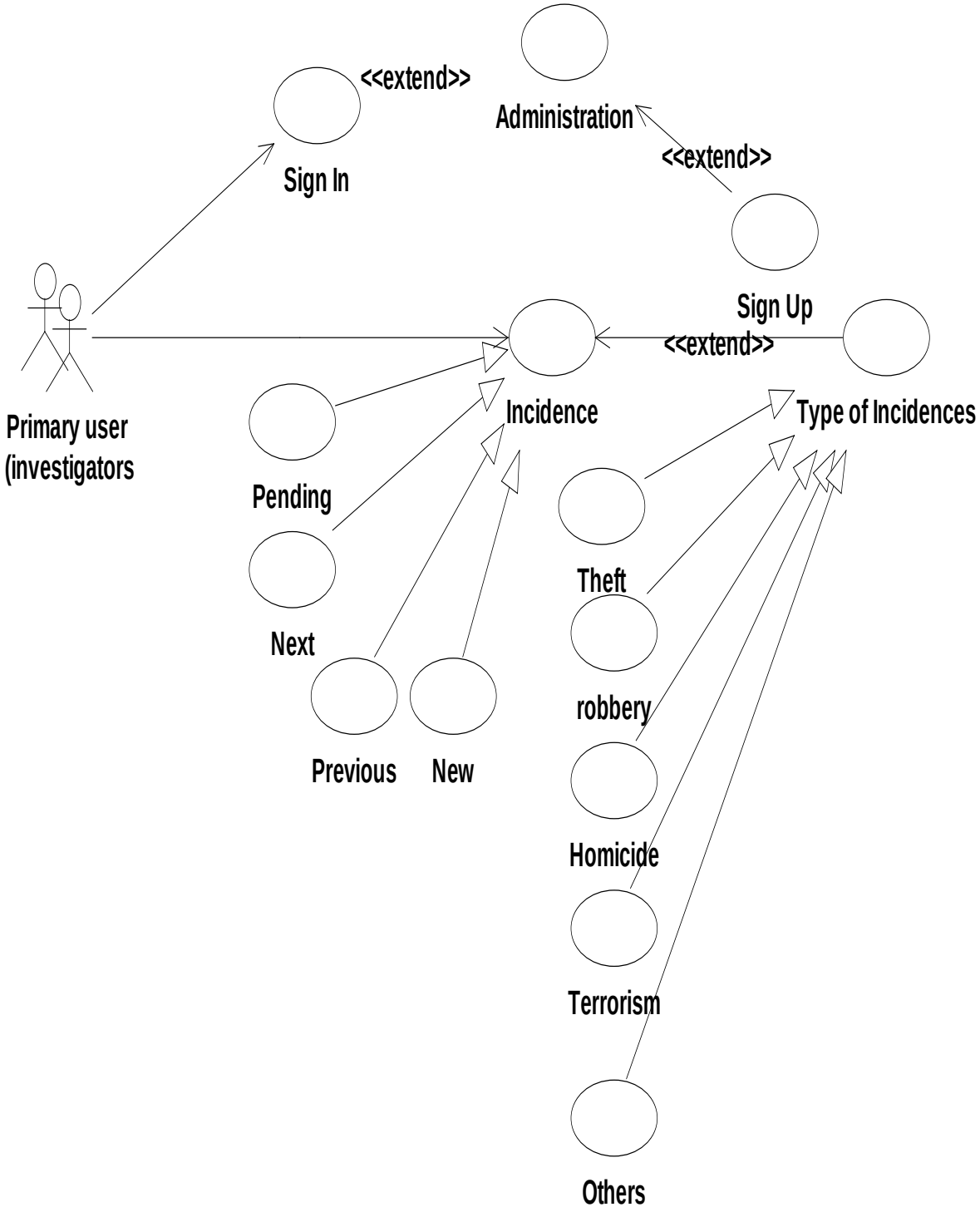

<<extend>>
Administration
<<extend>>
Sign In
Sign Up
<<extend>>
Primary user
(investigators
Incidence
Type of Incidences
Pending
Next
Previous
New
Theft
robbery
Homicide
Terrorism
Others

Fig 4.3 Use case (Investigator View)

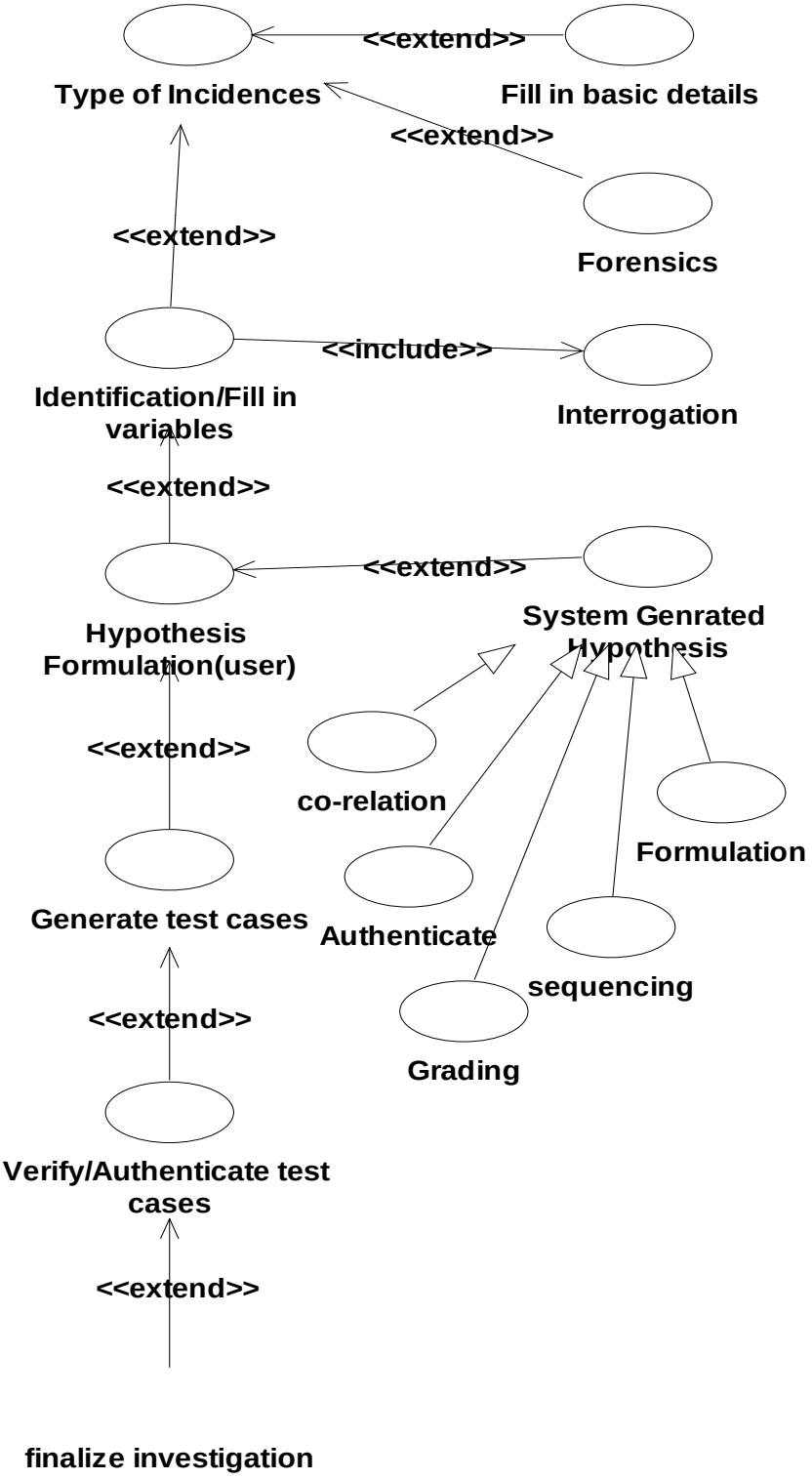

<<extend>>
Type of Incidences
Fill in basic details
<<extend>>
<<extend>>
Forensics
<<include>>
Identification/Fill in variables
Interrogation
<<extend>>
<<extend>>
Hypothesis Formulation(user)
System Genrated Hypothesis
<<extend>>
co-relation
Formulation
Generate test cases
Authenticate
sequencing
<<extend>>
Grading
Verify/Authenticate test cases
<<extend>>
finalize investigation

Fig 4.4 Use case (Investigator View: Incidence elaboration)

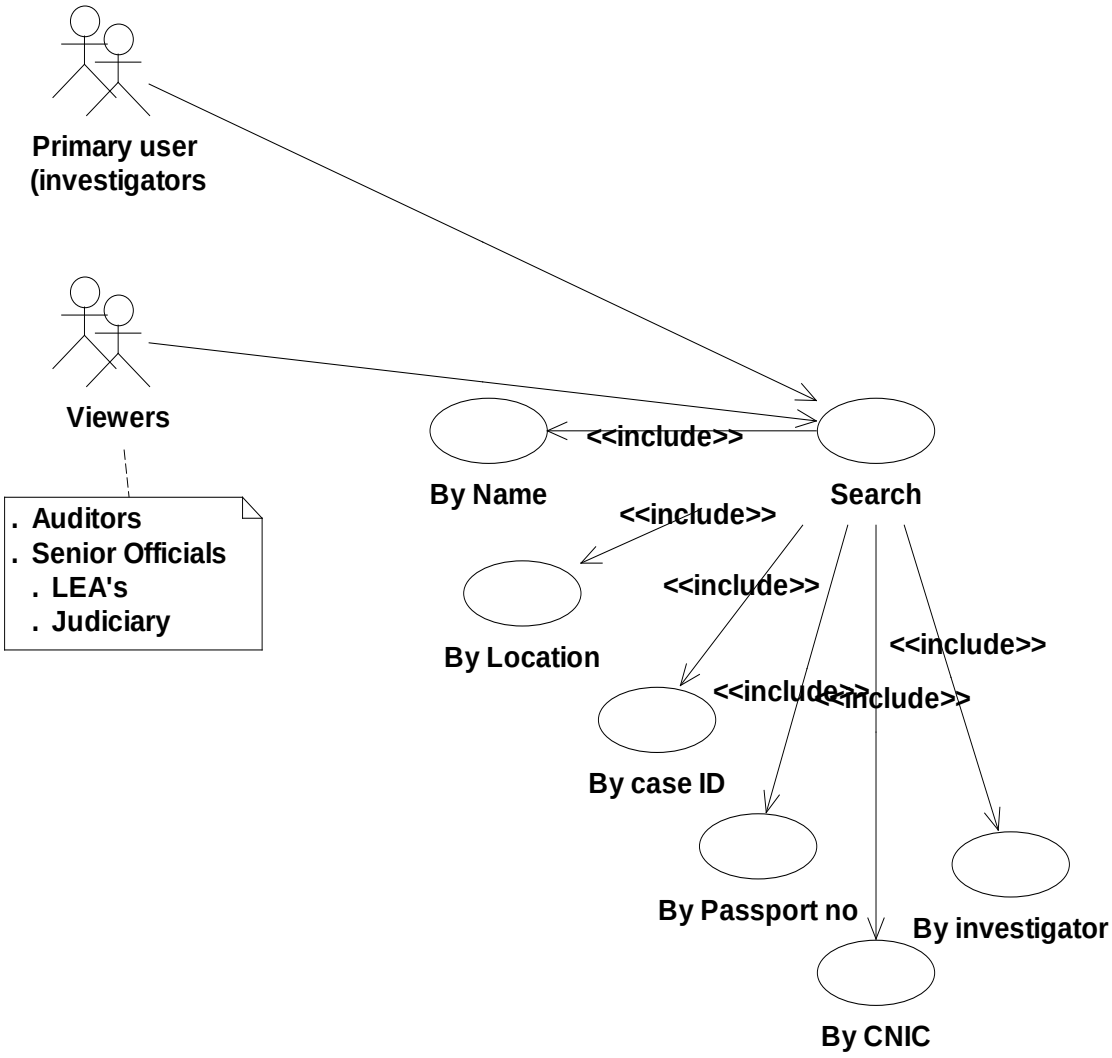


Fig 4.5 Use case (Viewer)

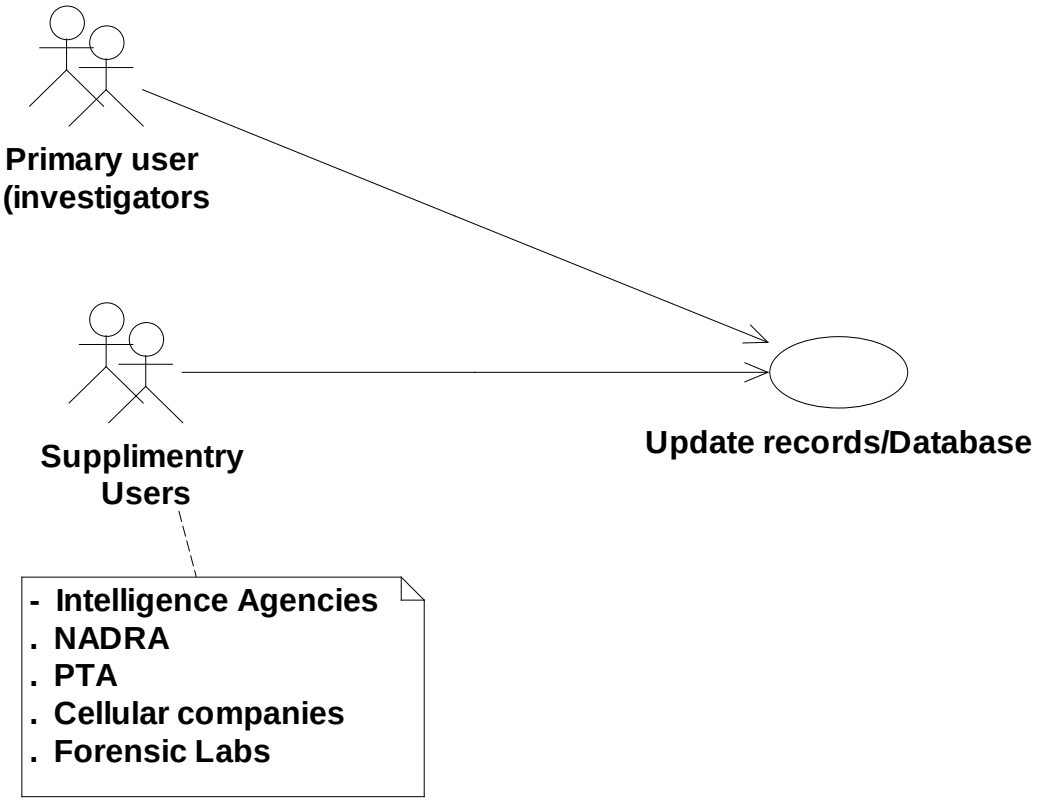


Fig 4.6 Use case (Supplementary User View)

4.3.2. Sequence Diagram(Incidence):

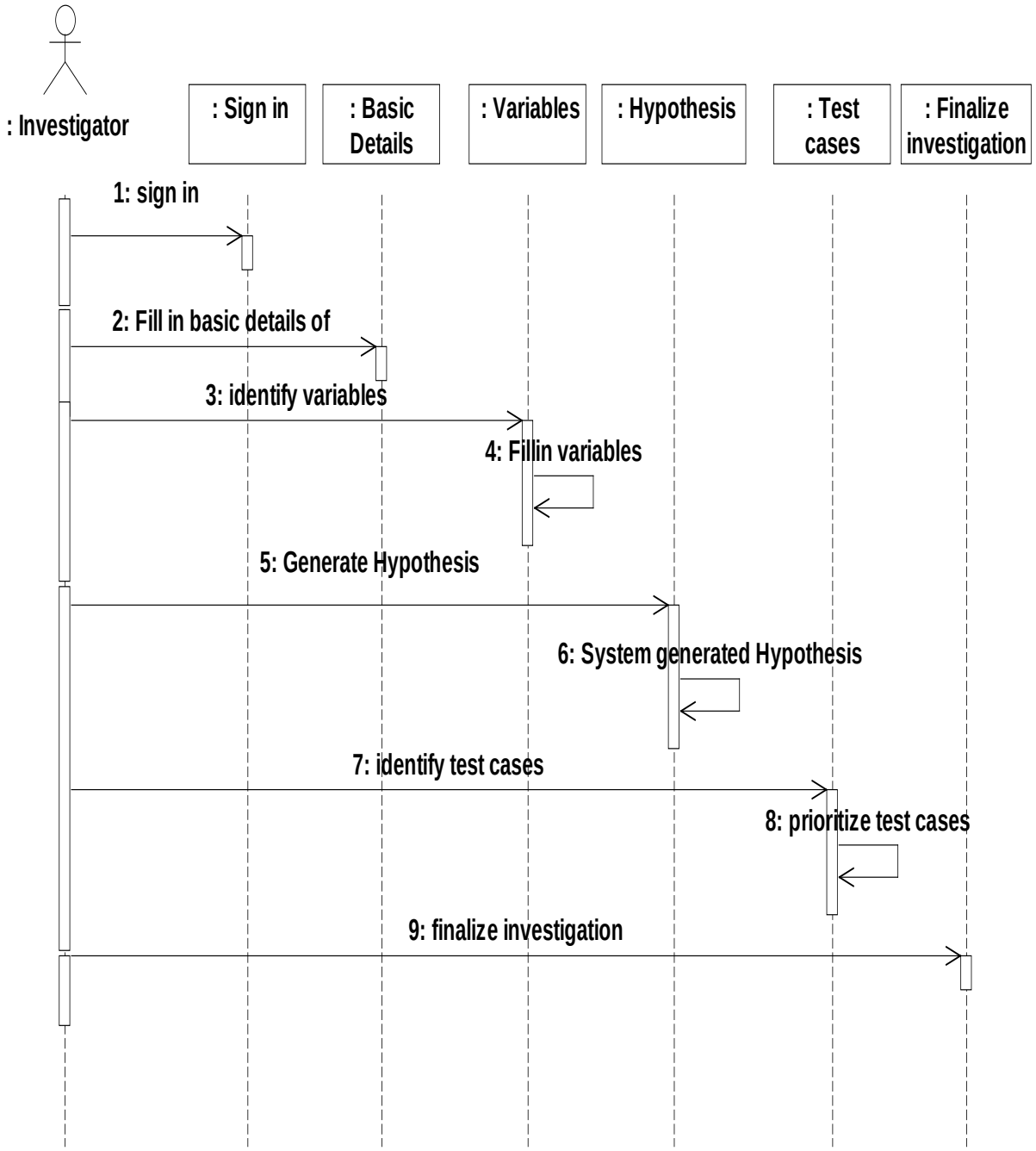


Fig 4.7 Sequence diagram (For incidence only)

4.3.3. State transition diagram:

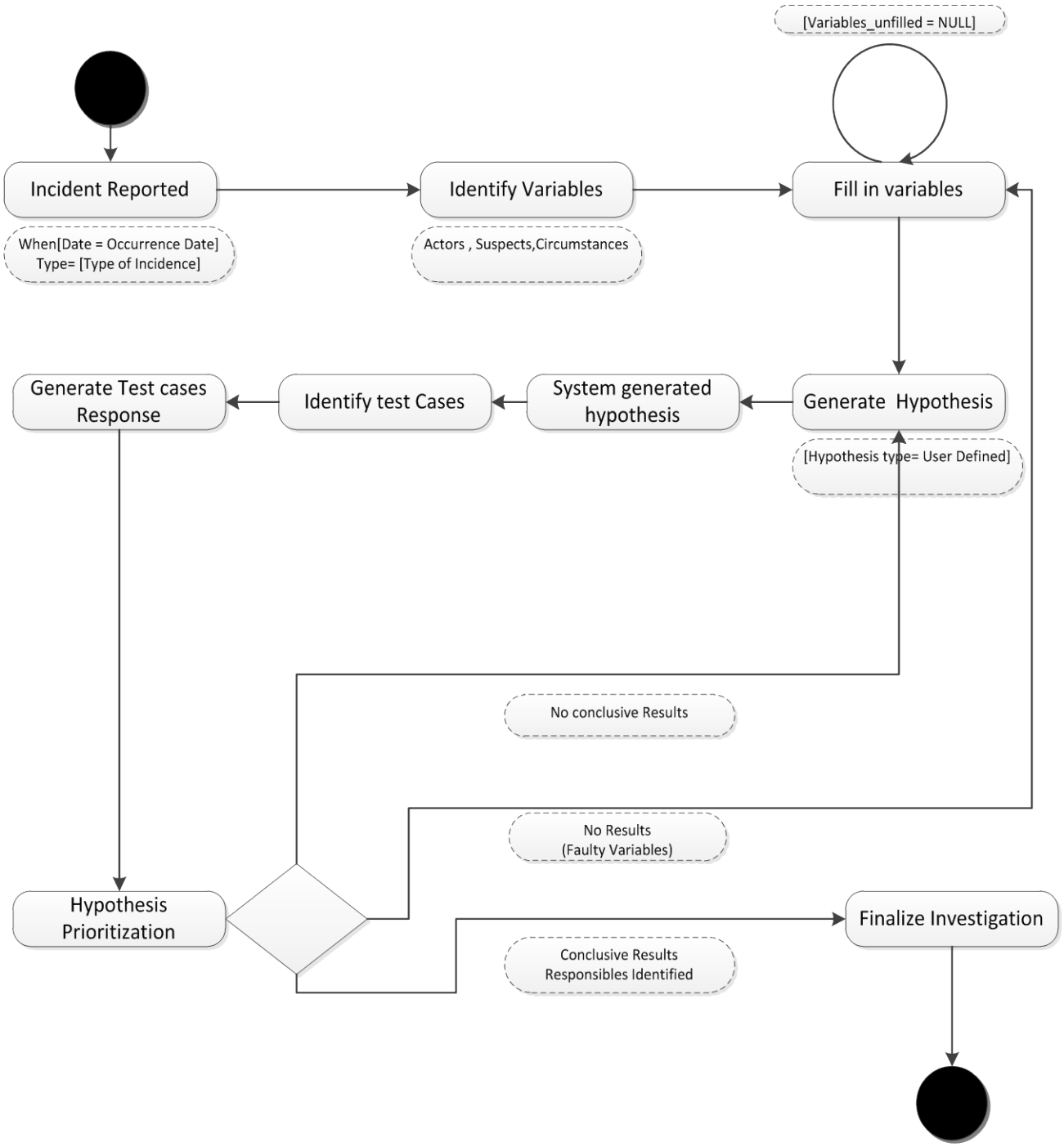
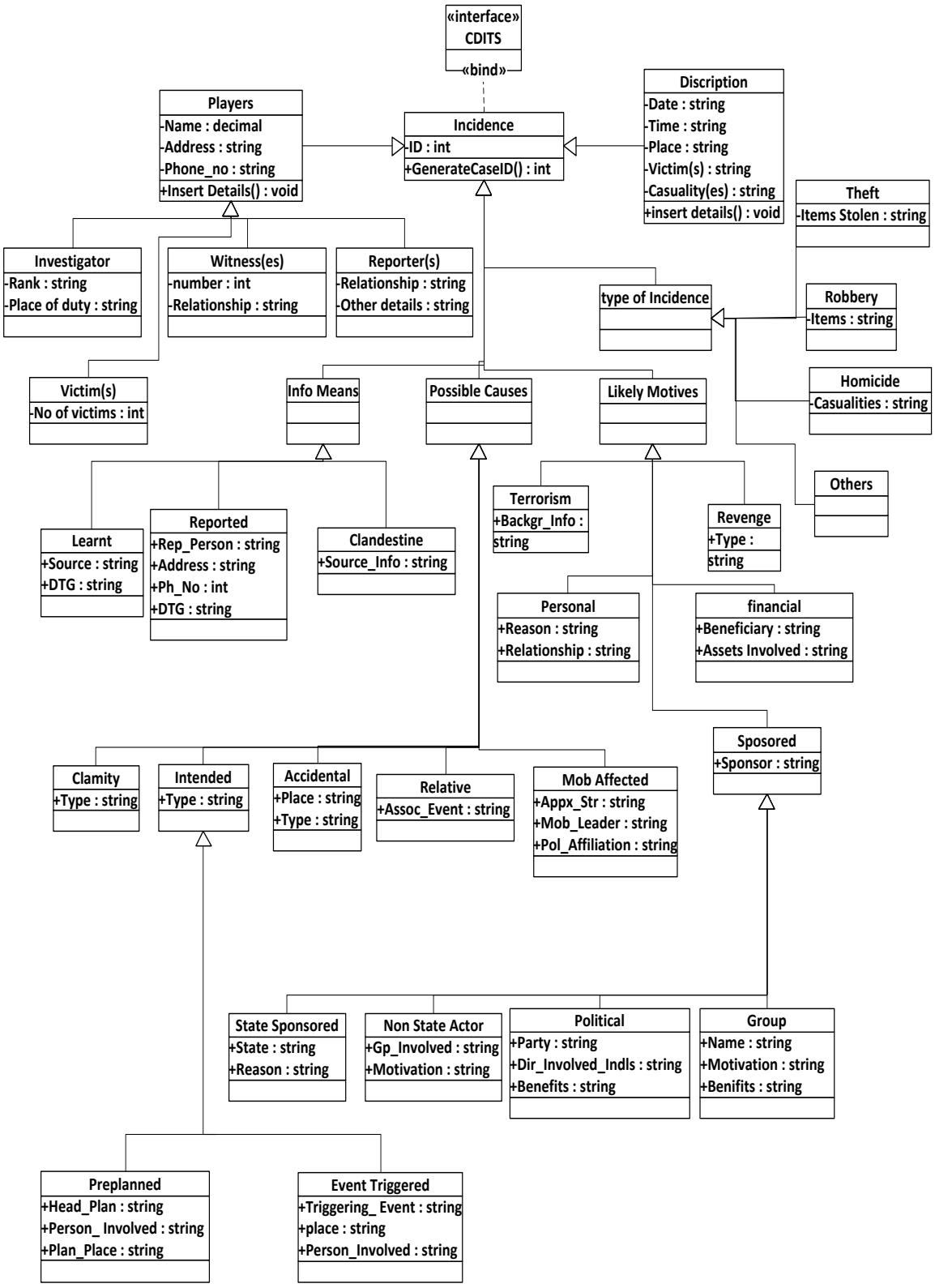
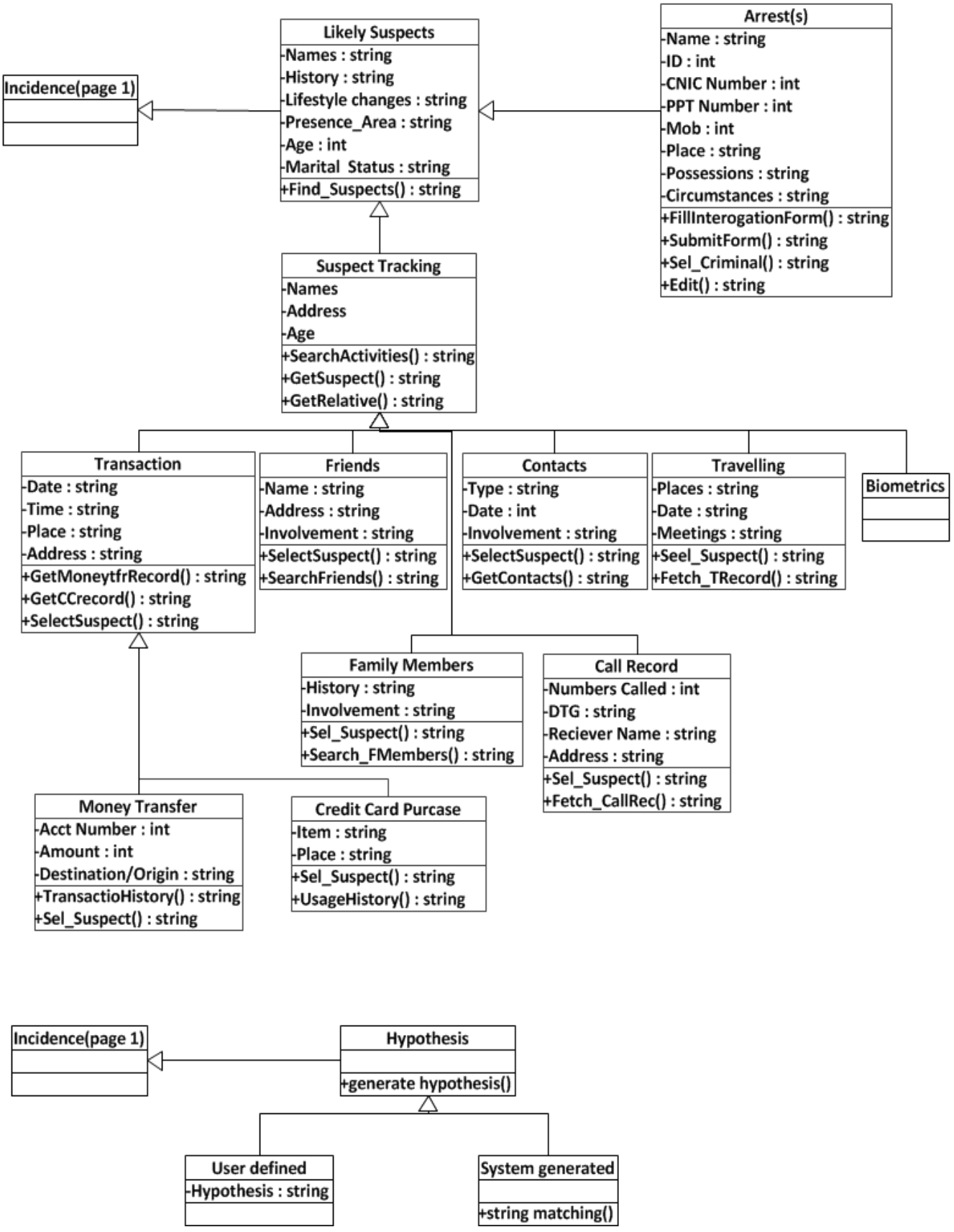


Fig 4.8 State Transition diagram (For incidence only)

4.3.4. **Class diagram:**


«interface»
CDITS
«bind»
Players
-Name : decimal
-Address : string
-Phone_no : string
+Insert Details() : void
Incidence
-ID : int
+GenerateCaseID() : int
Discription
-Date : string
-Time : string
-Place : string
-Victim(s) : string
-Casuality(es) : string
+insert details() : void
Theft
-Items Stolen : string
Investigator
-Rank : string
-Place of duty : string
Witness(es)
-number : int
-Relationship : string
Reporter(s)
-Relationship : string
-Other details : string
type of Incidence
Robbery
-Items : string
Victim(s)
-No of victims : int
Info Means
Possible Causes
Likely Motives
Homicide
-Casualities : string
Others
Terrorism
+Backgr_Info : string
Revenge
+Type : string
Learnt
+Source : string
+DTG : string
Reported
+Rep_Person : string
+Address : string
+Ph_No : int
+DTG : string
Clandestine
+Source_Info : string
Personal
+Reason : string
+Relationship : string
financial
+Beneficiary : string
+Assets Involved : string
Sposored
+Sponsor : string
Clamity
+Type : string
Intended
+Type : string
Accidental
+Place : string
+Type : string
Relative
+Assoc_Event : string
Mob Affected
+Appx_Str : string
+Mob_Leader : string
+Pol_Affiliation : string
State Sponsored
+State : string
+Reason : string
Non State Actor
+Gp_Involved : string
+Motivation : string
Political
+Party : string
+Dir_Involved_Indls : string
+Benefits : string
Group
+Name : string
+Motivation : string
+Benifits : string
Preplanned
+Head_Plan : string
+Person_ Involved : string
+Plan_Place : string
Event Triggered
+Triggering_ Event : string
+place : string
+Person_Involved : string


Incidence(page 1)
Likely Suspects
-Names : string
-History : string
-Lifestyle changes : string
-Presence_Area : string
-Age : int
-Marital Status : string
+Find_Suspects() : string
Arrest(s)
-Name : string
-ID : int
-CNIC Number : int
-PPT Number : int
-Mob : int
-Place : string
-Possessions : string
-Circumstances : string
+FillInterogationForm() : string
+SubmitForm() : string
+Sel_Criminal() : string
+Edit() : string
Suspect Tracking
-Names
-Address
-Age
+SearchActivities() : string
+GetSuspect() : string
+GetRelative() : string
Transaction
-Date : string
-Time : string
-Place : string
-Address : string
+GetMoneytfrRecord() : string
+GetCCrecord() : string
+SelectSuspect() : string
Friends
-Name : string
-Address : string
-Involvement : string
+SelectSuspect() : string
+SearchFriends() : string
Contacts
-Type : string
-Date : int
-Involvement : string
+SelectSuspect() : string
+GetContacts() : string
Travelling
-Places : string
-Date : string
-Meetings : string
+Seel_Suspect() : string
+Fetch_TRecord() : string
Biometrics
Family Members
-History : string
-Involvement : string
+Sel_Suspect() : string
+Search_FMembers() : string
Call Record
-Numbers Called : int
-DTG : string
-Reciever Name : string
-Address : string
+Sel_Suspect() : string
+Fetch_CallRec() : string
Money Transfer
-Acct Number : int
-Amount : int
-Destination/Origin : string
+TransactioHistory() : string
+Sel_Suspect() : string
Credit Card Purcase
-Item : string
-Place : string
+Sel_Suspect() : string
+UsageHistory() : string
Incidence(page 1)
Hypothesis
+generate hypothesis()
User defined
-Hypothesis : string
System generated
+string matching()

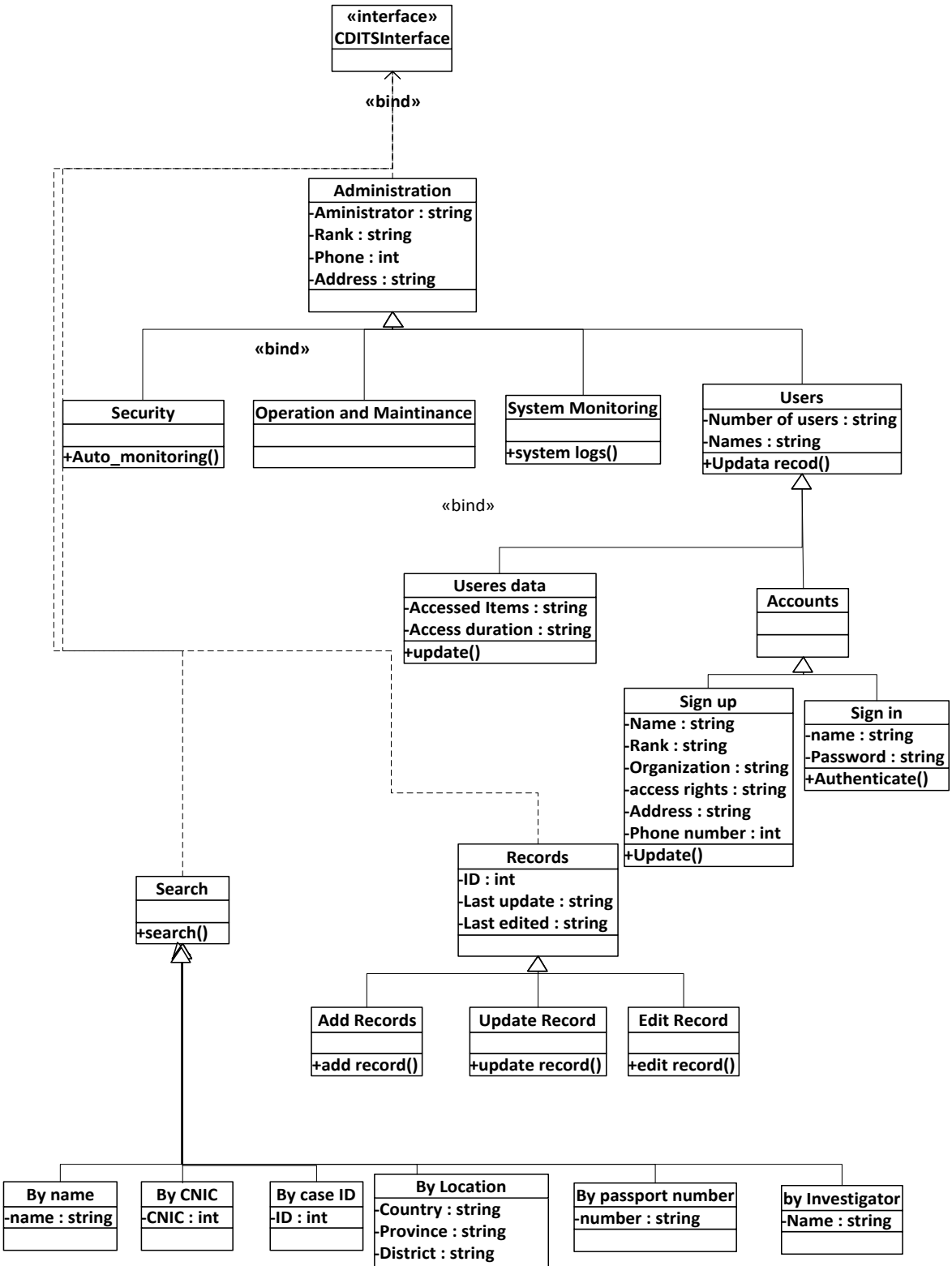
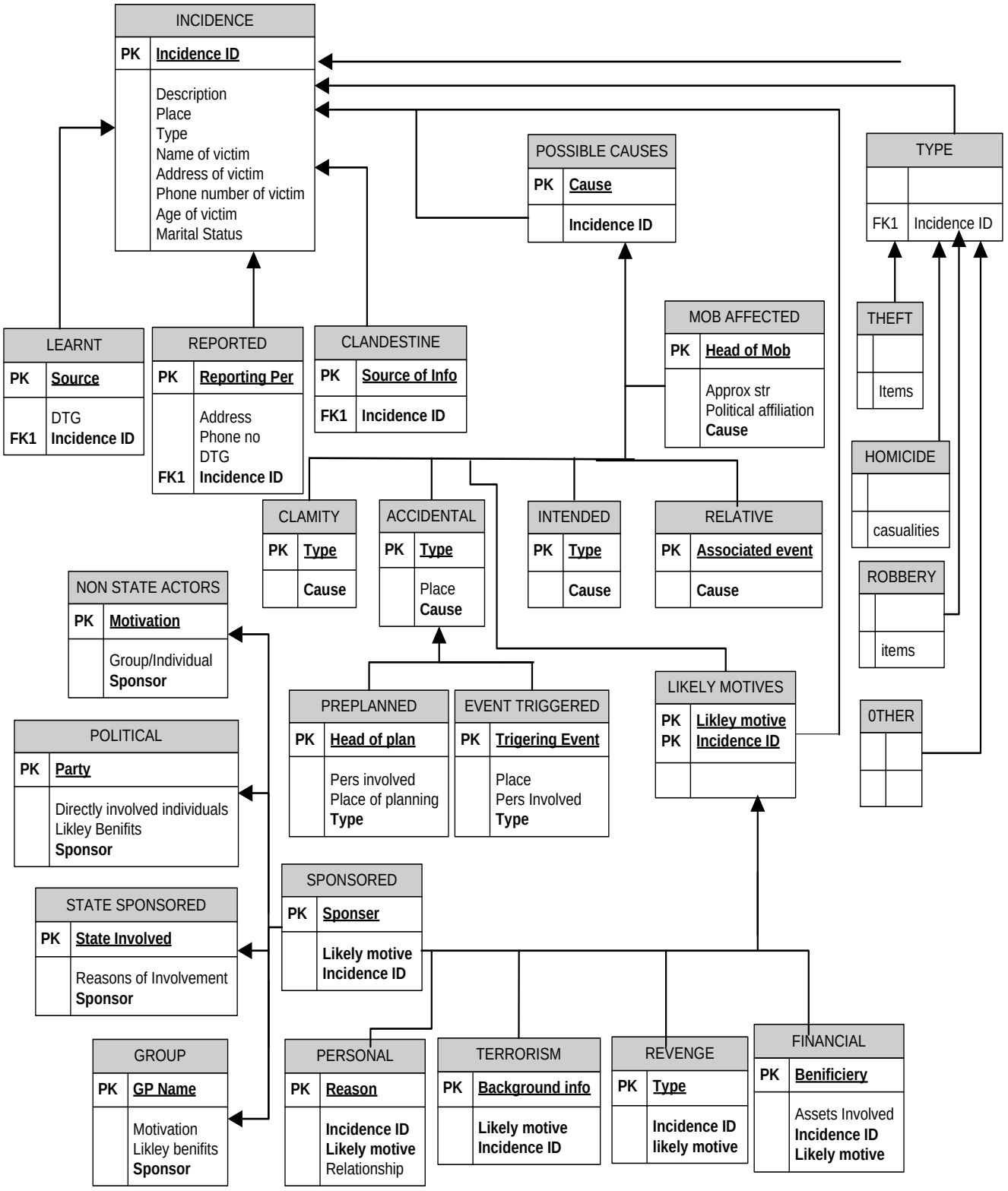
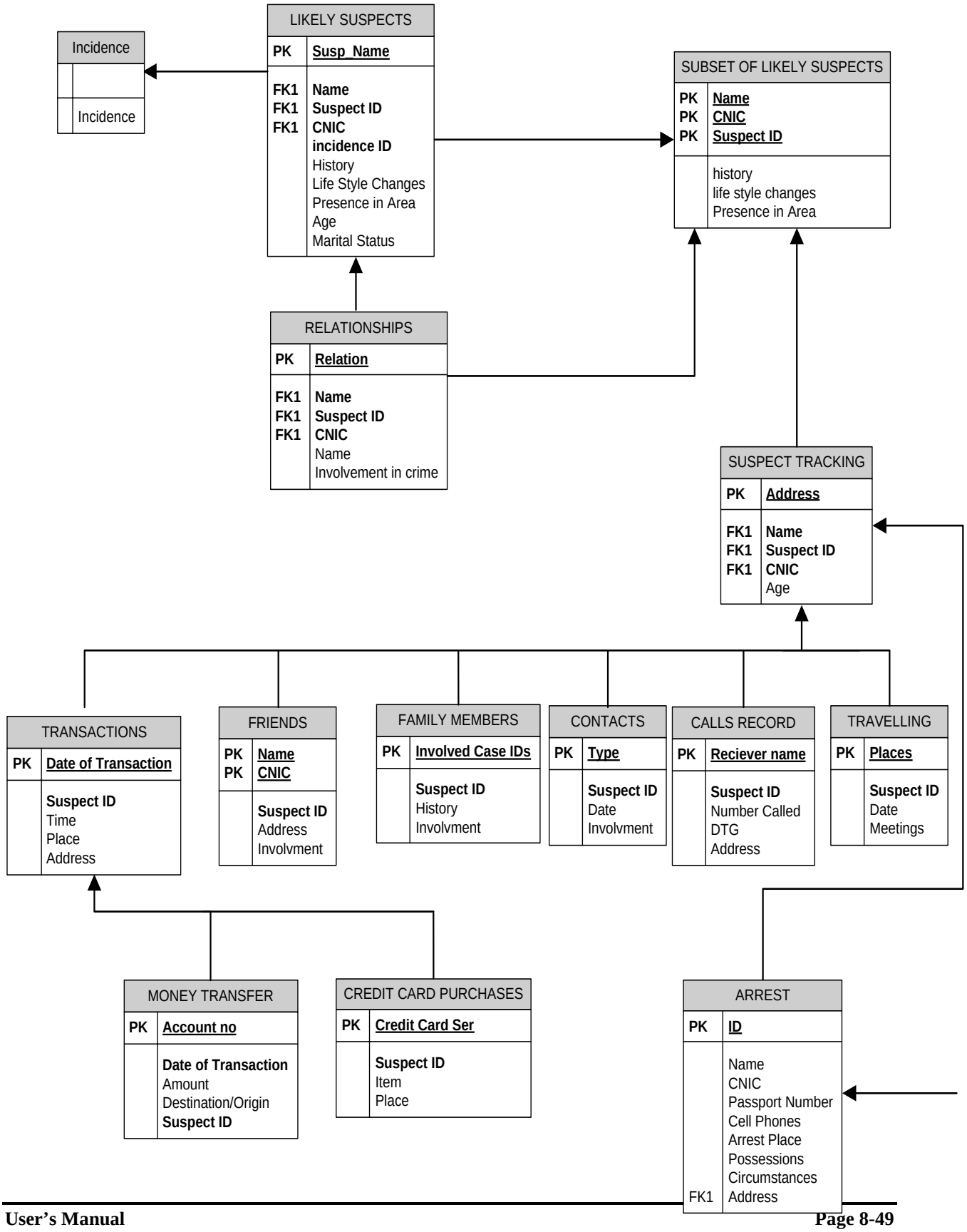

«interface»
CDITSInterface
«bind»
Administration
-Aministrator : string
-Rank : string
-Phone : int
-Address : string
«bind»
Security
+Auto_monitoring()
Operation and Maintinance
System Monitoring
+system logs()
Users
-Number of users : string
-Names : string
+Updata recod()
«bind»
Useres data
-Accessed Items : string
-Access duration : string
+update()
Accounts
Sign up
-Name : string
-Rank : string
-Organization : string
-access rights : string
-Address : string
-Phone number : int
+Update()
Sign in
-name : string
-Password : string
+Authenticate()
Records
-ID : int
-Last update : string
-Last edited : string
Search
+search()
Add Records
+add record()
Update Record
+update record()
Edit Record
+edit record()
By name
-name : string
By CNIC
-CNIC : int
By case ID
-ID : int
By Location
-Country : string
-Province : string
-District : string
-village : string
-Police station : string
By passport number
-number : string
by Investigator
-Name : string

Fig 4.9 class diagram (Page 4)

4.3.5. ER Diagram




Incidence
Incidence
LIKELY SUSPECTS
PK Susp_Name
FK1 Name
FK1 Suspect ID
FK1 CNIC
incidence ID
History
Life Style Changes
Presence in Area
Age
Marital Status
SUBSET OF LIKELY SUSPECTS
PK Name
PK CNIC
PK Suspect ID
history
life style changes
Presence in Area
RELATIONSHIPS
PK Relation
FK1 Name
FK1 Suspect ID
FK1 CNIC
Name
Involvement in crime
SUSPECT TRACKING
PK Address
FK1 Name
FK1 Suspect ID
FK1 CNIC
Age
TRANSACTIONS
PK Date of Transaction
Suspect ID
Time
Place
Address
FRIENDS
PK Name
PK CNIC
Suspect ID
Address
Involvment
FAMILY MEMBERS
PK Involved Case IDs
Suspect ID
History
Involvment
CONTACTS
PK Type
Suspect ID
Date
Involvment
CALLS RECORD
PK Reciever name
Suspect ID
Number Called
DTG
Address
TRAVELLING
PK Places
Suspect ID
Date
Meetings
MONEY TRANSFER
PK Account no
Date of Transaction
Amount
Destination/Origin
Suspect ID
CREDIT CARD PURCHASES
PK Credit Card Ser
Suspect ID
Item
Place
ARREST
PK ID
Name
CNIC
Passport Number
Cell Phones
Arrest Place
Possessions
Circumstances
FK1 Address

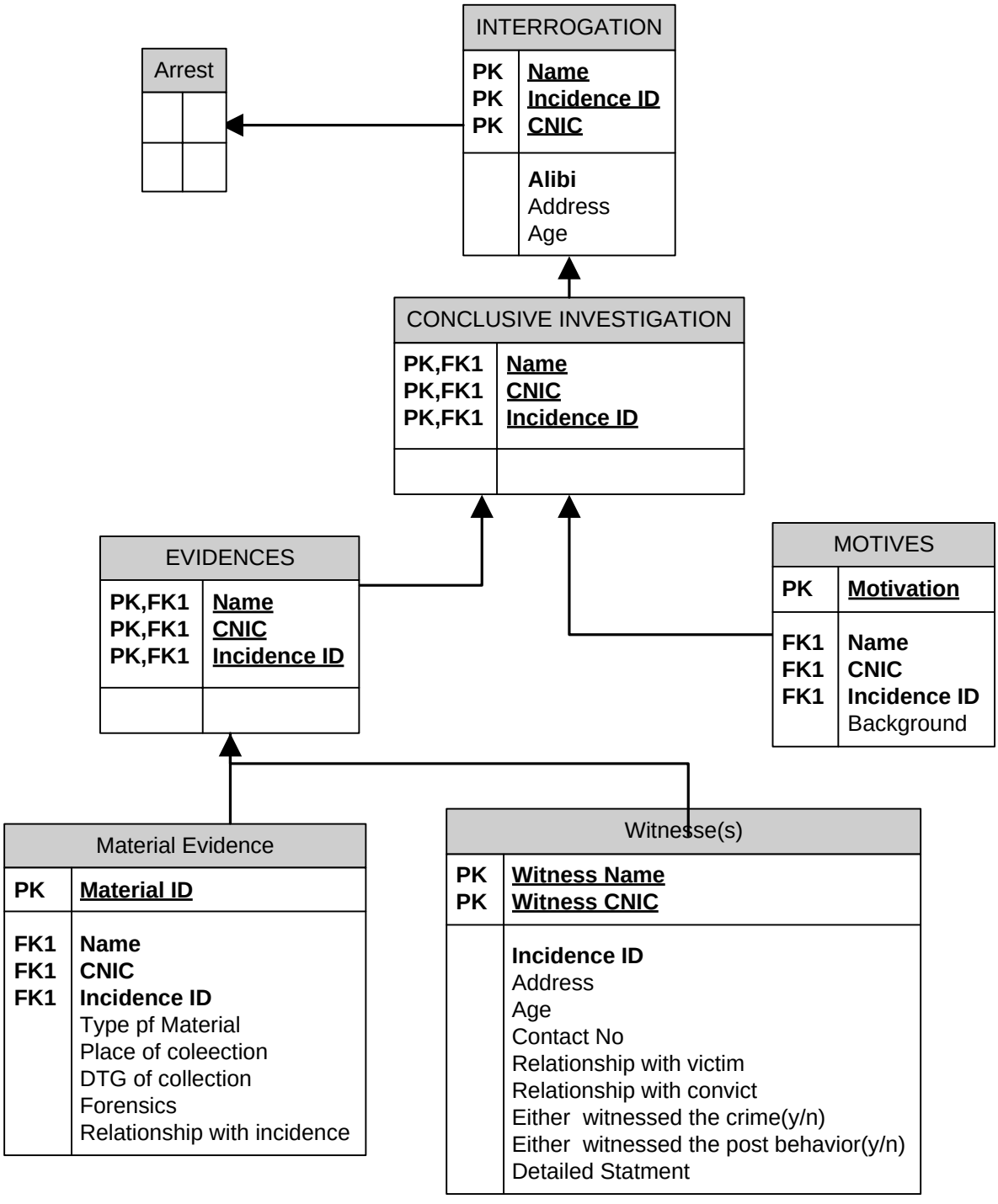

Arrest
INTERROGATION
PK Name
PK Incidence ID
PK CNIC
Alibi
Address
Age
CONCLUSIVE INVESTIGATION
PK,FK1 Name
PK,FK1 CNIC
PK,FK1 Incidence ID
EVIDENCES
PK,FK1 Name
PK,FK1 CNIC
PK,FK1 Incidence ID
MOTIVES
PK Motivation
FK1 Name
FK1 CNIC
FK1 Incidence ID
Background
Material Evidence
PK Material ID
FK1 Name
FK1 CNIC
FK1 Incidence ID
Type pf Material
Place of coleection
DTG of collection
Forensics
Relationship with incidence
Witnesse(s)
PK Witness Name
PK Witness CNIC
Incidence ID
Address
Age
Contact No
Relationship with victim
Relationship with convict
Either witnessed the crime(y/n)
Either witnessed the post behavior(y/n)
Detailed Statment

Fig 4.10 ER diagram

4.3.6. **Hypertext Model:**

4.3.6.1. **Investigator**.

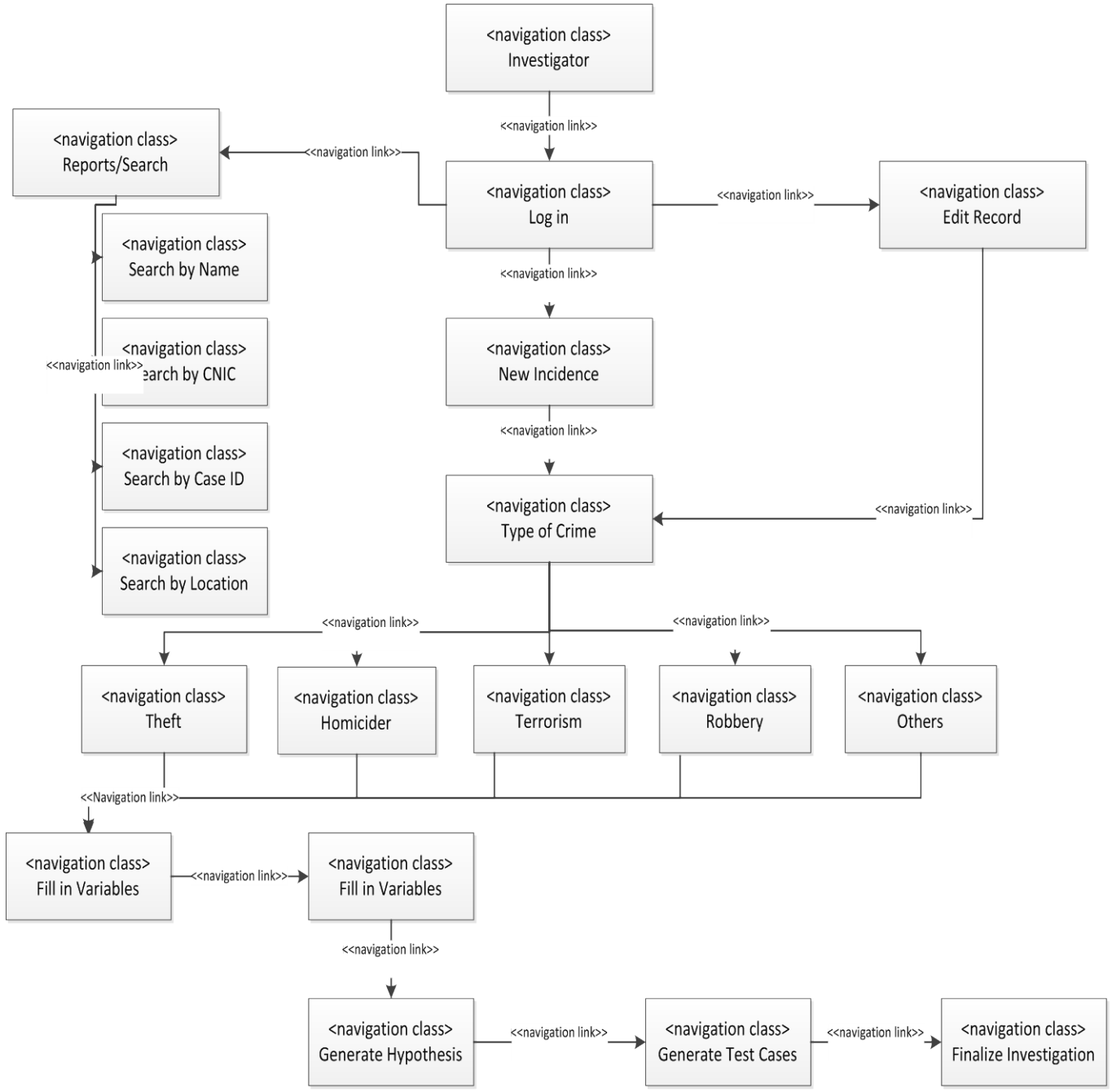


Fig 4.11 Hypertext Model (Investigation)

4.3.6.2. **Viewer.**

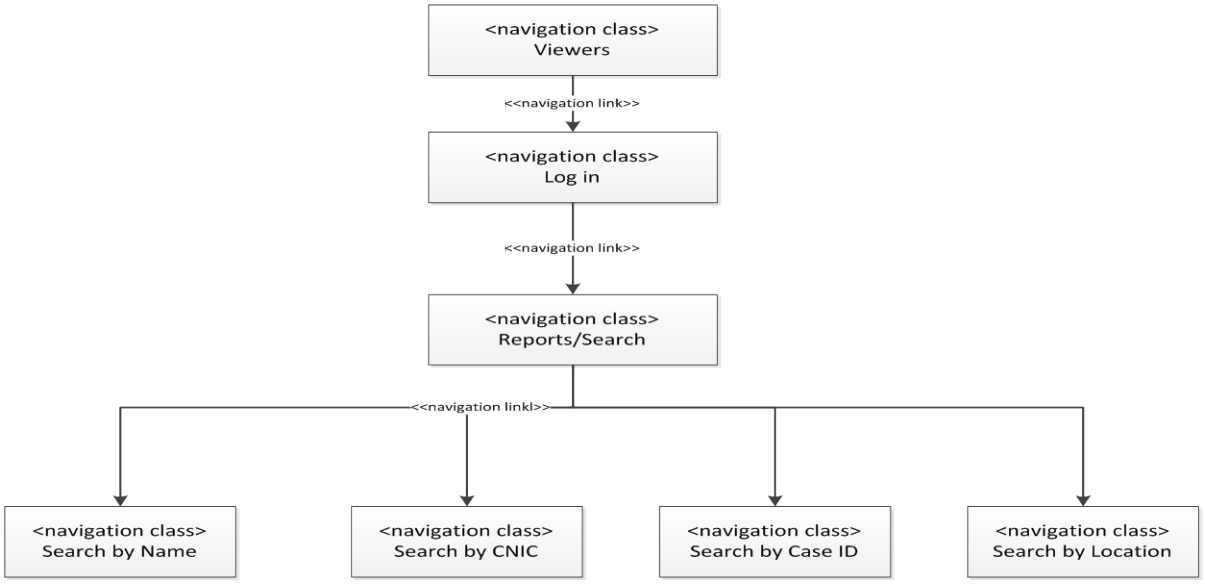


Fig 4.12 Hypertext Model (Viewer)

4.3.6.3. **Update.**

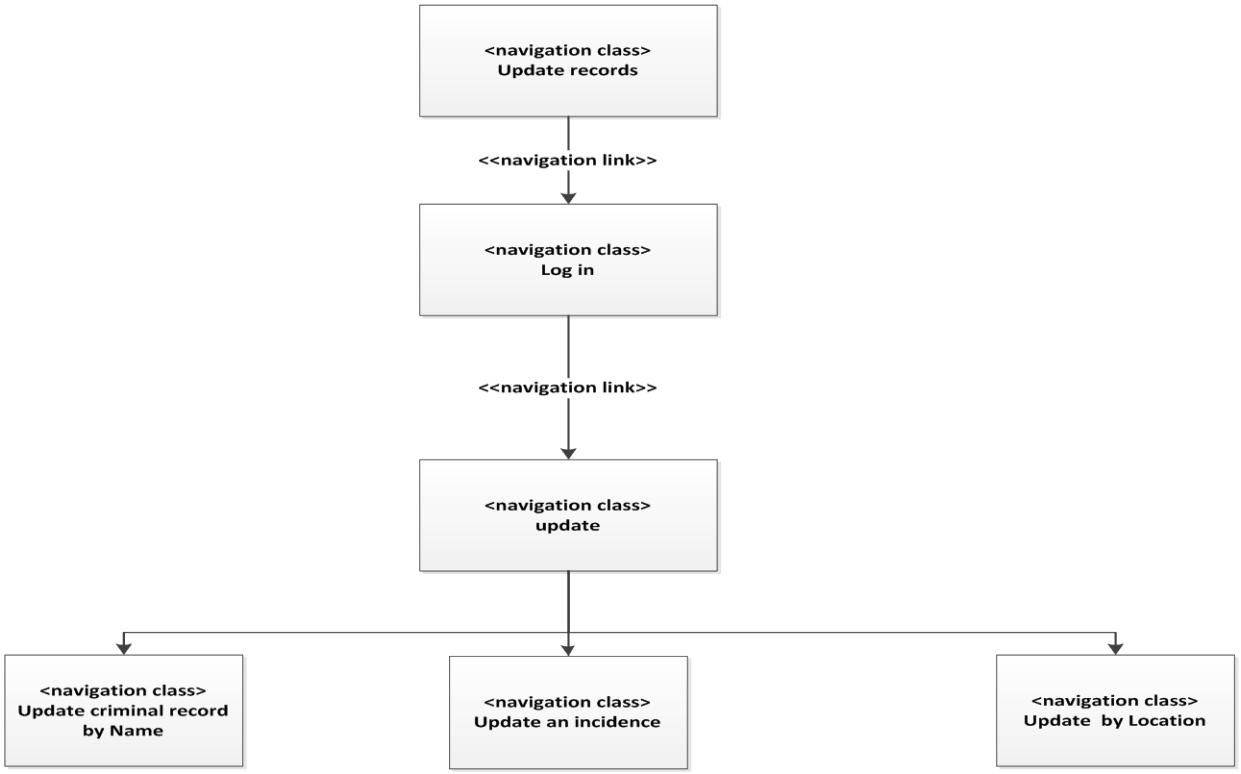


Fig 4.13 Hypertext Model (Update)

CHAPTER: 5

System Implementation

5.1. Implementation Technologies

The system has been developed as web based application incorporating following tiers:

5.1.1. **Back end**: Relational DB using SQL Server

5.1.2. **Front end**: Dynamic website using ASP.net

5.1.3. **Query language**: LINQ (Language Integrated Query)

5.2. Modules

Implemented System in itself is a module of a larger picture of CDITS. It is further subdivided into four sub modules :

5.2.1. **Investigator Module:**

Investigators are the primary users of the system. Investigator can start investigation in four categories i.e. Theft, Murder, Kidnapping and Terrorism as shown in the fig.

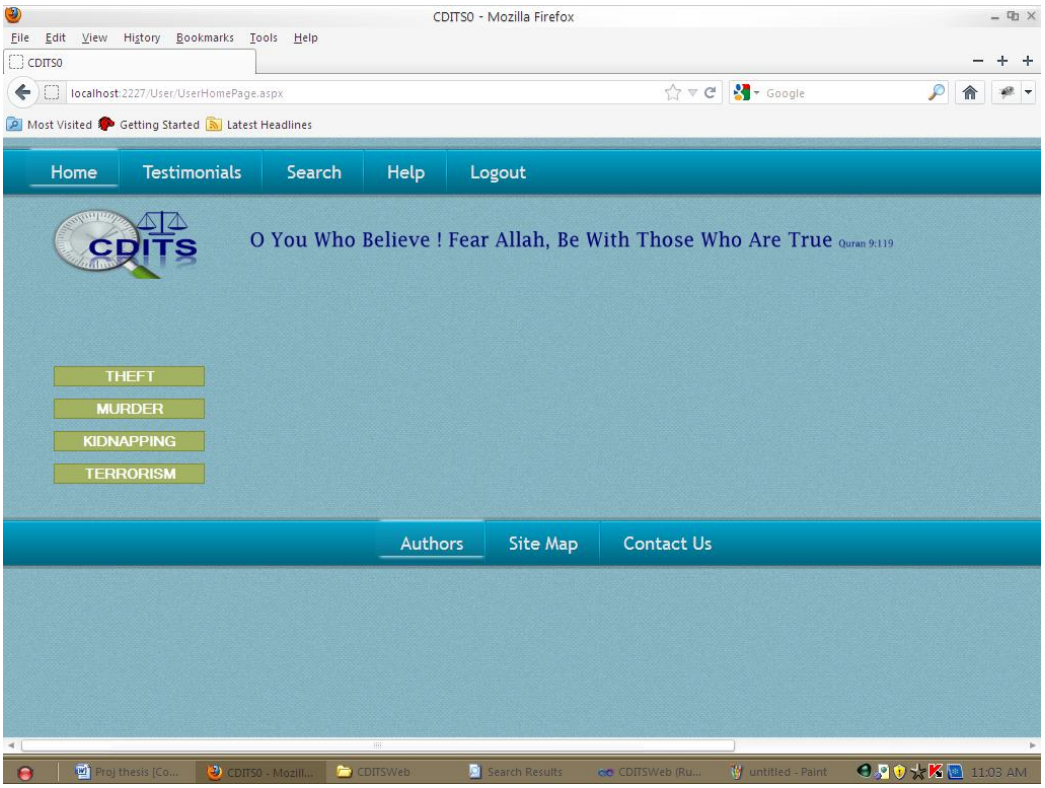


Fig 5.1 Investigator Main Page

After selecting crime type, investigator fills in the details of crime and starts investigation process, which includes:

5.2.1.1. Basic details of Incidence (fig 5.2)

5.2.1.2. Investigation (fig 5.3)

5.2.1.3. Hypothesis (fig 5.4)

5.2.1.4. Daily Progress (fig 5.5)

5.2.1.5. Case Summary (fig 5.6)

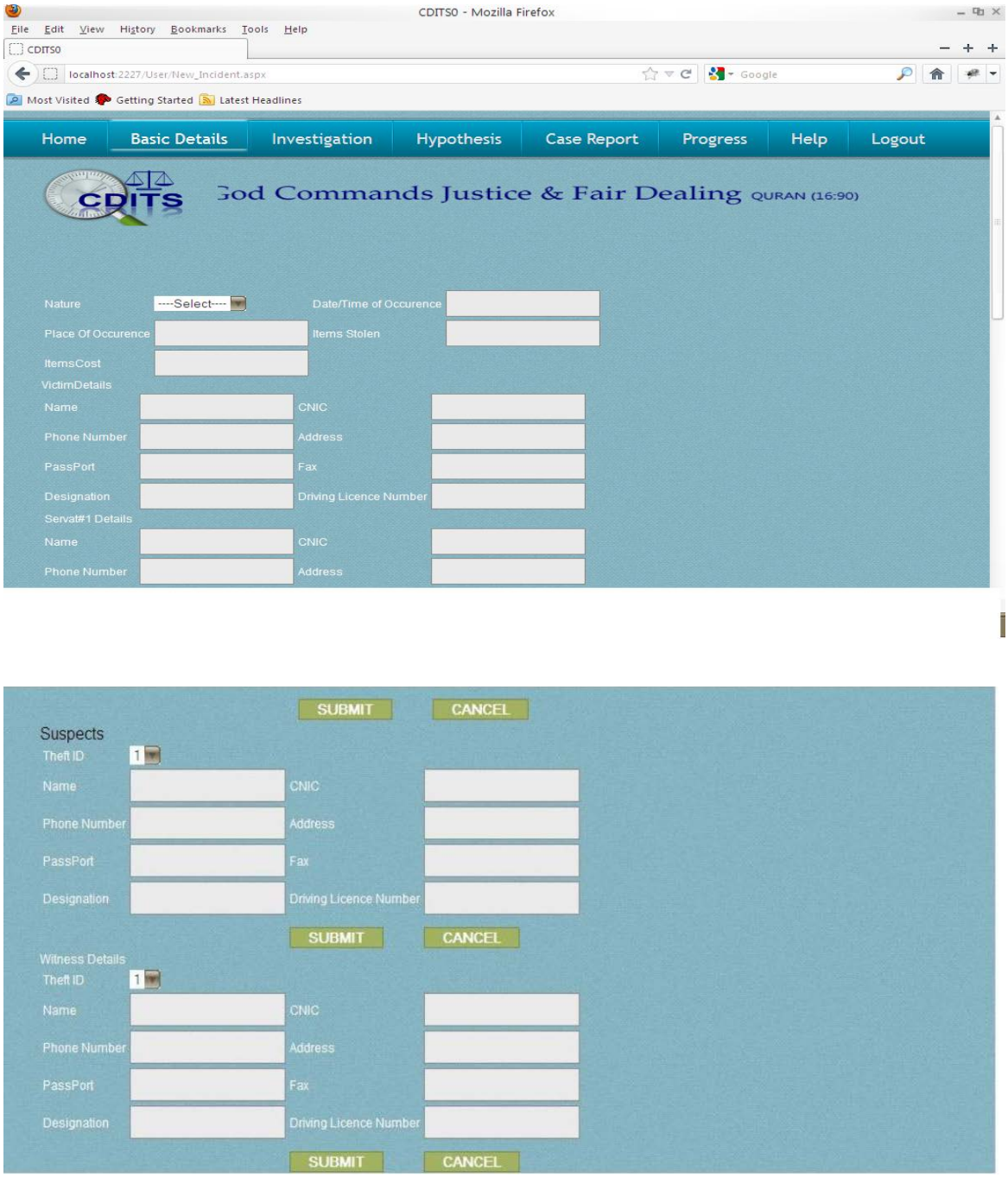


Fig 5.2 Basic Details of Incidence

Investigation include, statements of witnesses, victim and suspects (as shown in fig 5.3)

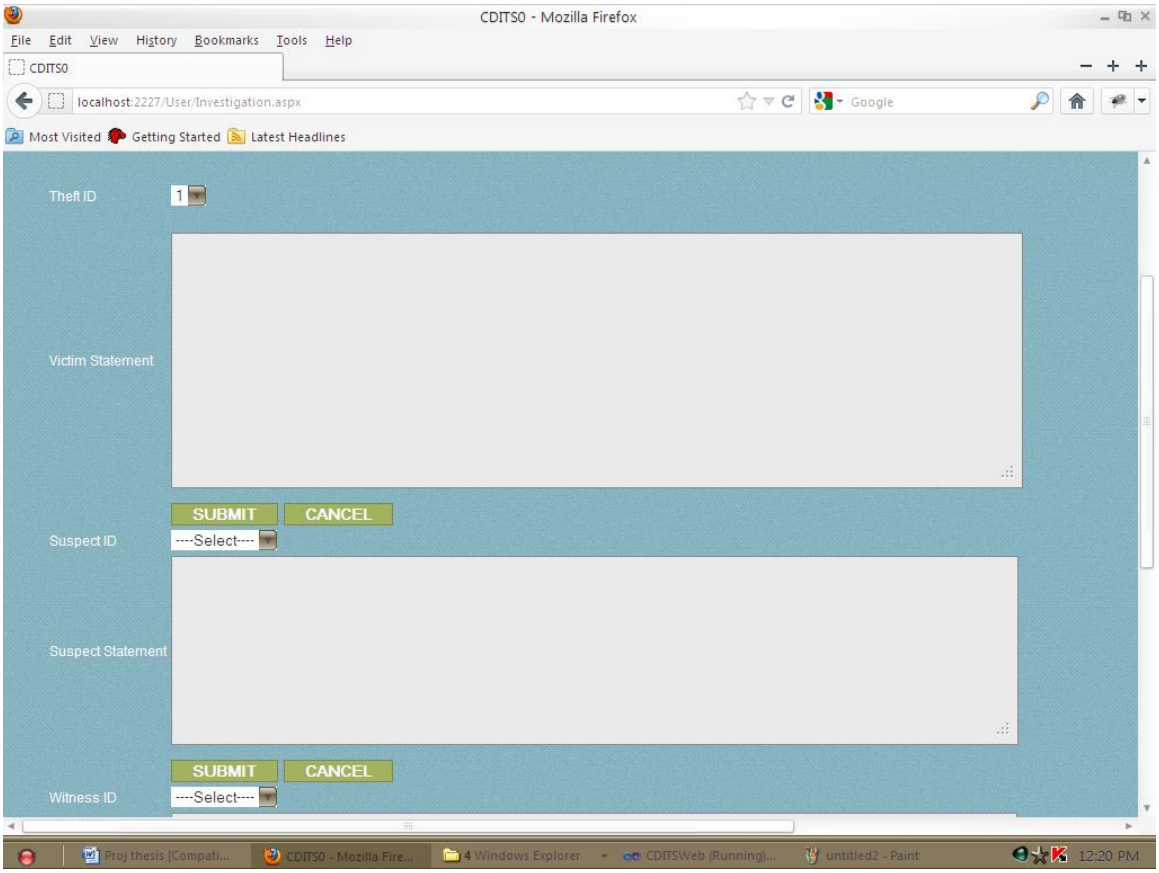


Fig 5.3 Investigation

After gathering basic details and statements of main actors, now investigator is ready to make hypothesis. Hypotheses are manual and computer generated. Manual Hypothesis includes Hypothesis, generating test case against each hypothesis and then validating it. This complete procedure will be done manually by investigator (as shown in fig 5.4). Computer generated hypothesis will be discussed in sec……, as it is implemented as a separate Artificial Intelligence Module.

Fig 5.4 User generated Hypothesis

Investigator will fill in the daily progress Performa (fig 5.5), on daily basis. It will give a glimpse of complete on the progress of case.

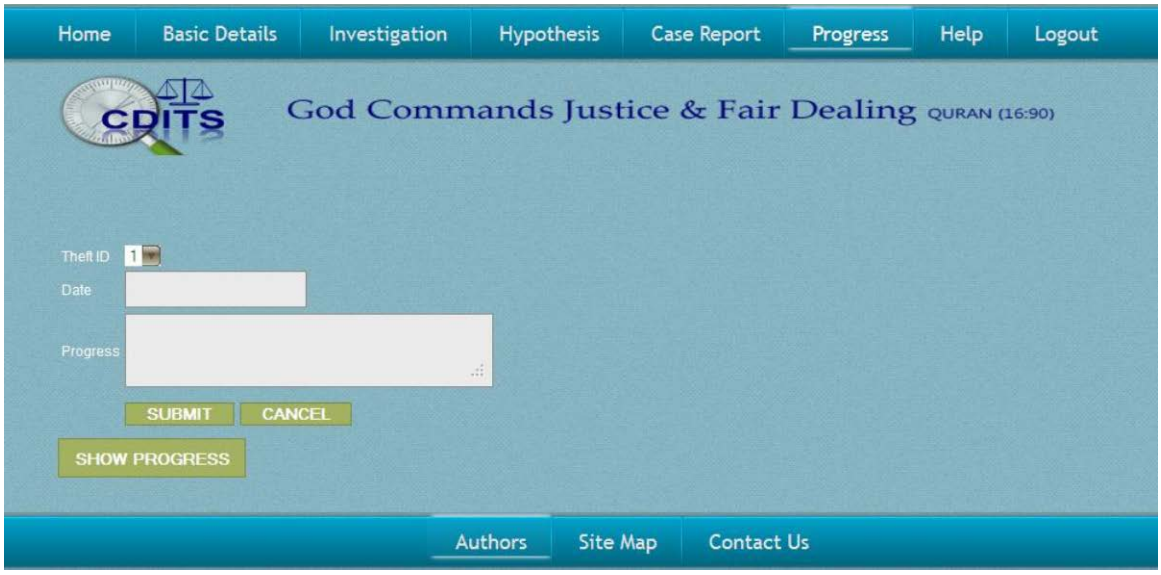


Fig 5.5 Daily Progresses

At the end of investigation, case report will be generated on the case report form (fig 5.6)

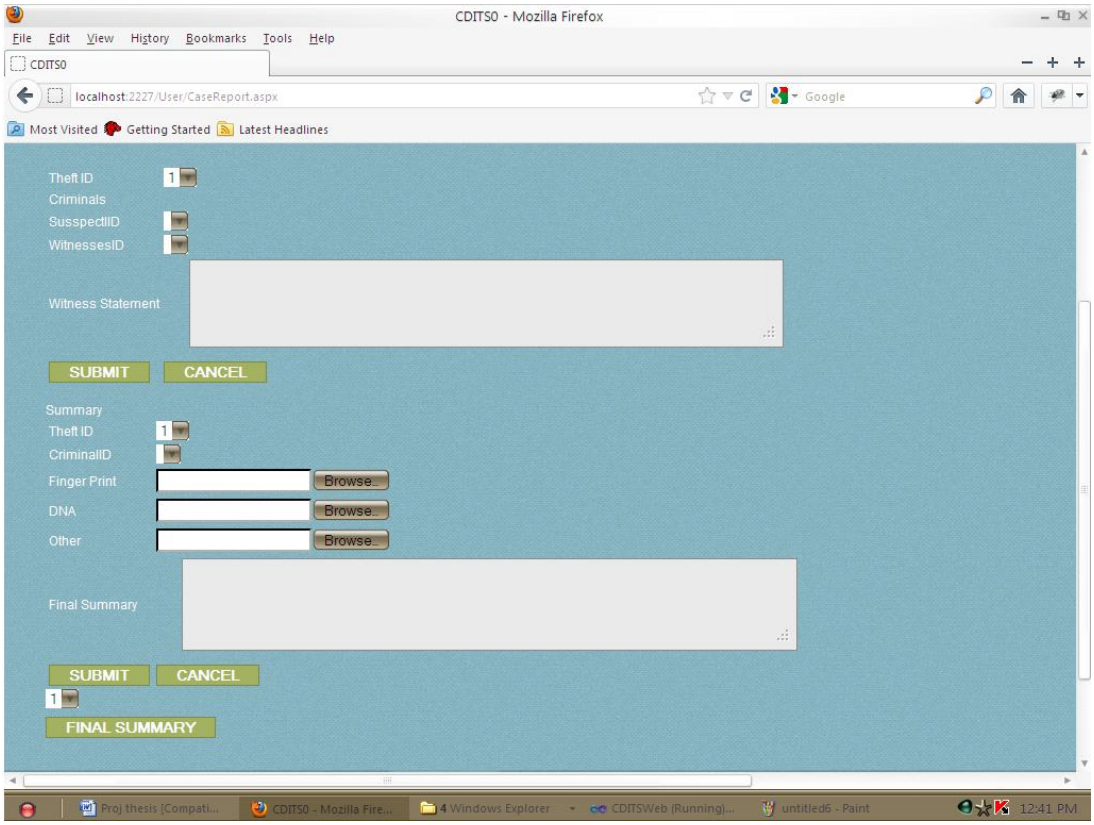


Fig 5.6 Case Summary

5.2.2. Artificial Intelligence (Fuzzy Logic Implementation):

5.2.2.1. **Fuzzy Sets.** Fuzzy sets, unlike classical sets, do not restrict themselves to something lying wholly in either set A or in set not-A. They let things sit on the fence, and are thus closer to the human world. Let us, for example, take into consideration ‘days of the weekend’. The classical set would say strictly that only Saturday and Sunday are a part of weekend, whereas most of us would agree that we do feel like it’s a weekend somewhat on Friday as well. Actually we’re more excited about the weekend on a Friday than on Sunday, because on

Sunday we know that the next day is a working day. This concept is more vividly shown in the fig 5.5.

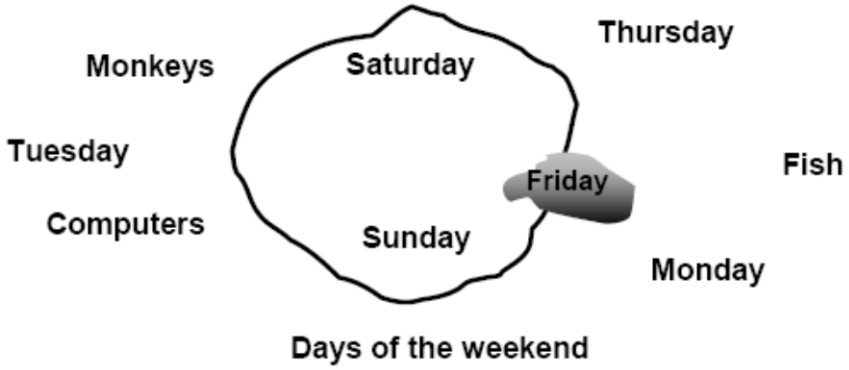


Fig 5.7 Fuzzy set

Another diagram that would help distinguish between crisp and fuzzy representation of days of the weekend is shown below.

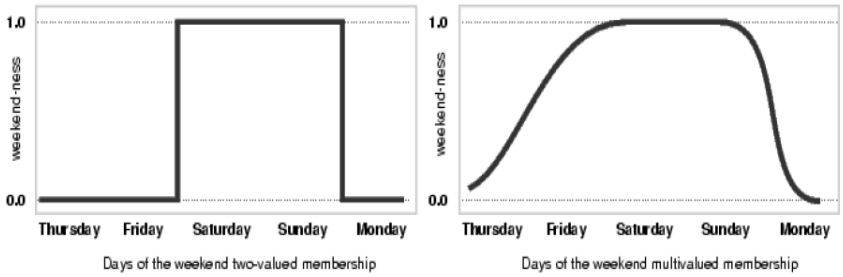


Fig 5.8 Fuzzy set

The left side of the above figure shows the crisp set ‘days of the weekend’, which is a Boolean two-valued function, so it gives a value of 0 for all week

days except Saturday and Sunday where it gives an abrupt 1 and then back to 0 as soon as Sunday ends. On the other hand, Fuzzy set is a multi-

valued function, which in this case is shown by a smoothly rising curve for the weekend, and even Friday has a good membership in the set ‘days of the weekend’.

5.2.2.2. **Fuzzy Logic:** Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partial truth -- truth values between "completely true" and "completely false". Dr. Lotfi Zadeh of UC/Berkeley introduced it in the 1960's as a means to model the uncertainty of natural languages. He was faced with a lot of criticism but today the vast number of fuzzy logic applications speak for themselves:

5.2.2.2.1. Self-focusing cameras

5.2.2.2.2. Washing machines that adjust themselves according to the dirtiness of the clothes

5.2.2.2.3. Automobile engine controls

5.2.2.2.4. Anti-lock braking systems

5.2.2.2.5. Color film developing systems

5.2.2.2.6. Subway control systems

5.2.2.2.7. Computer programs trading successfully in financial markets

5.2.2.3. **Fuzzy Logic System (FLS).** FIS consists of four main parts as shown in fig 5.8

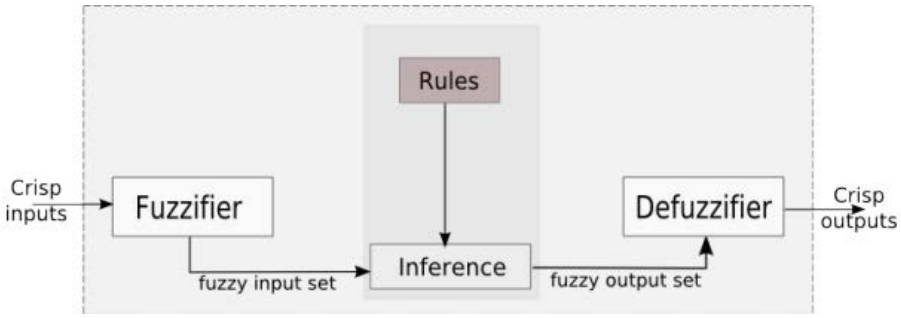


Fig 5.9 Fuzzy Logic System

Fuzzy inference process has five main parts.

5.2.2.3.1. Fuzzification of the input variables

5.2.2.3.2. Application of Rules

5.2.2.3.3. Implication from antecedent to consequent.

5.2.2.3.4. Aggregation of consequents across the rules

5.2.2.3.5. Defuzzification of output

5.2.2.4. **Implementation of Fuzzy Logic in CDITS.** Fuzzy logic has been used in CDITS to access the level of suspicion of a suspect. Level of suspicion is going to be always fuzzy, till the time we have ascertained the suspect as a criminal. It helps us in categorizing the suspects so that maximum attention can be diverted on the important suspects. We will take theft as type of crime and implement fuzzy algorithm step by step.

Inputs/outputs:

Attributes that are associated with a theft crime are our inputs to the system,

which are

5.2.2.4.1. Previous history of suspect

5.2.2.4.2. Presence at crime scene

5.2.2.4.3. Alibi

5.2.2.4.4. Account details of suspect

5.2.2.4.5. Witnesses available

5.2.2.4.6. Material Evidence available

5.2.2.4.7. Probability of suspicion (output)

5.2.2.5. **Example: Dinner of Two:** A small case study is presented which will be used for better understanding of system.

Two people go for a dinner to a restaurant. Our fuzzy system will help them decide the percentage of tip to be given to the waiter (between 5 to 25 percent of the total bill), based on their rating of service and food. The rating is between 0 and 10. The system is based on three fuzzy rules:

Rule1:

If service is poor or food is rancid then tip is cheap

Rule2:

If service is good then tip is average

Rule3:

If service is excellent or food is delicious then tip is generous.

5.2.2.6. **Fuzzify Inputs/output:** After identifying inputs next step is to fuzzify the inputs i.e. A crisp

numerical value limited to the universe of discourse of the input variable (in this case the interval between 0 and 10) and the output is a fuzzy degree of membership in the qualifying linguistic set (always the interval between 0 and 100). Code that implements the above discussion is shown below.

```
FuzzyVariable history = new FuzzyVariable("PreviousHistory", 0.0, 10.0);
        history.Terms.Add(new FuzzyTerm("clean", new
TriangularMembershipFunction(5.0, 0.0, 5.0)));
        history.Terms.Add(new FuzzyTerm("average", new
TriangularMembershipFunction(0.0, 5.0, 10.0)));
        history.Terms.Add(new FuzzyTerm("dirty", new
TriangularMembershipFunction(5.0, 10.0, 15.0)));
        Probability.Input.Add(history);

FuzzyVariable Account = new FuzzyVariable("AccountDetail", 0.0, 10.0);
        Account.Terms.Add(new FuzzyTerm("unchanged", new
TriangularMembershipFunction(0.0, 2.0,5.0)));
        Account.Terms.Add(new FuzzyTerm("incremental", new
TriangularMembershipFunction(1.0, 3.0, 7.0)));
        Account.Terms.Add(new FuzzyTerm("spent", new
TriangularMembershipFunction(6.0, 7.0, 10.0)));
        Probability.Input.Add(Account);

FuzzyVariable Evidence = new FuzzyVariable("MaterialEvidence", 0.0, 10.0);
        Evidence.Terms.Add(new FuzzyTerm("low", new
TriangularMembershipFunction(5.0, 0.0, 5.0)));
        Evidence.Terms.Add(new FuzzyTerm("average", new
TriangularMembershipFunction(0.0, 5.0, 10.0)));
        Evidence.Terms.Add(new FuzzyTerm("strong", new
TriangularMembershipFunction(5.0, 10.0, 15.0)));
```

```
            Probability.Input.Add(Evidence);

        FuzzyVariable RelationshipWV = new FuzzyVariable("Relationship", 0.0, 100.0);
            RelationshipWV.Terms.Add(new FuzzyTerm("NoRelation", new
        TriangularMembershipFunction(0.0, 2.0, 5.0)));
            RelationshipWV.Terms.Add(new FuzzyTerm("Known", new
        TriangularMembershipFunction(1.0, 3.0, 7.0)));
            RelationshipWV.Terms.Add(new FuzzyTerm("Close", new
        TriangularMembershipFunction(6.0, 7.0, 10.0)));
            Probability.Input.Add(RelationshipWV);

        FuzzyVariable Presence = new FuzzyVariable("CurrentPresence", 0.0, 100.0);
            Presence.Terms.Add(new FuzzyTerm("Present", new
        TriangularMembershipFunction(0.0, 2.0, 5.0)));
            Presence.Terms.Add(new FuzzyTerm("StatusnotClear", new
        TriangularMembershipFunction(2.0, 5.0, 10.0)));
            Presence.Terms.Add(new FuzzyTerm("Missing", new
        TriangularMembershipFunction(5.0, 10.0, 15.0)));
            Probability.Input.Add(Presence);

        FuzzyVariable Alibi = new FuzzyVariable("Alibi", 0.0, 100.0);
            Alibi.Terms.Add(new FuzzyTerm("Strong", new
        TriangularMembershipFunction(0.0, 2.0, 5.0)));
            Alibi.Terms.Add(new FuzzyTerm("Satisfactory", new
        TriangularMembershipFunction(2.0, 5.0, 8.0)));
            Alibi.Terms.Add(new FuzzyTerm("Poor", new
        TriangularMembershipFunction(5.0, 8.0, 10.0)));
            Probability.Input.Add(Alibi);
        ////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
        /
        FuzzyVariable Probability1 = new FuzzyVariable("SuspectProbability", 0.0, 100.0);
            Probability1.Terms.Add(new FuzzyTerm("Safe", new
        TriangularMembershipFunction(0.0, 15.0, 30.0)));
```

```
Probability1.Terms.Add(new FuzzyTerm("Considerable", new
TriangularMembershipFunction(30.0, 55.0, 70.0)));
Probability1.Terms.Add(new FuzzyTerm("MostProbable", new
TriangularMembershipFunction(70.0, 85.0, 100.0)));
Probability.Output.Add(Probability1);
```

5.2.2.7. **Rules:** Rules depends on resolving the inputs into a number of different fuzzy linguistic sets: Alibi is poor, Alibi is satisfactory, Alibi is strong, Relationship is known, Relationship is Close and so on. Code that implements the Rules is shown below.

```
MamdaniFuzzyRule rule1 = Probability.ParseRule("if ((PreviousHistory is
dirty)) then SuspectProbability is MostProbable");

MamdaniFuzzyRule rule2 = Probability.ParseRule("if ( PreviousHistory is
dirty )  or (MaterialEvidence is strong) then SuspectProbability is
MostProbable");

MamdaniFuzzyRule rule3 = Probability.ParseRule("if ((PreviousHistory is
clean)) then SuspectProbability is Safe");

MamdaniFuzzyRule rule4 = Probability.ParseRule("if ( AccountDetail is
incremental) then SuspectProbability is Considerable");

MamdaniFuzzyRule rule5 = Probability.ParseRule("if ((MaterialEvidence is
strong)) then SuspectProbability is MostProbable");

MamdaniFuzzyRule rule6 = Probability.ParseRule("if ((MaterialEvidence is
low)) then SuspectProbability is Safe");

MamdaniFuzzyRule rule7 = Probability.ParseRule("if ((CurrentPresence is
Missing)) then SuspectProbability is MostProbable");

MamdaniFuzzyRule rule8 = Probability.ParseRule("if ((Alibi is Poor)) then
SuspectProbability is MostProbable");

MamdaniFuzzyRule rule9 = Probability.ParseRule("if ( PreviousHistory is
dirty )  and (AccountDetail is incremental) then SuspectProbability is
MostProbable");
```

```
MamdaniFuzzyRule rule10 = Probability.ParseRule("if ( PreviousHistory is
clean)  or (MaterialEvidence is low) then SuspectProbability is Safe");

MamdaniFuzzyRule rule11 = Probability.ParseRule("if (Alibi  is  Poor)  and
(MaterialEvidence is strong) then SuspectProbability is MostProbable");

MamdaniFuzzyRule rule12 = Probability.ParseRule("if (CurrentPresence is
Missing) and (MaterialEvidence is strong)then SuspectProbability is
MostProbable");

MamdaniFuzzyRule rule13 = Probability.ParseRule("if ((Alibi is Strong)) then
SuspectProbability is Safe");

MamdaniFuzzyRule rule14 = Probability.ParseRule("if ((Alibi is
Satisfactory)) then SuspectProbability is Safe");
```

5.2.2.8. **Implication:** Use the degree of support for the entire rule to shape the output fuzzy set. The consequent of a fuzzy rule assigns an entire fuzzy set to the output. This fuzzy set is represented by a membership function that is chosen to indicate the qualities of the consequent. If the antecedent is only partially true, (i.e., is assigned a value less than 1), then the output fuzzy set is truncated according to the implication method.

In general, one rule by itself doesn't do much good. What is needed are two or more rules that can play off one another. The output of each rule is a fuzzy set.

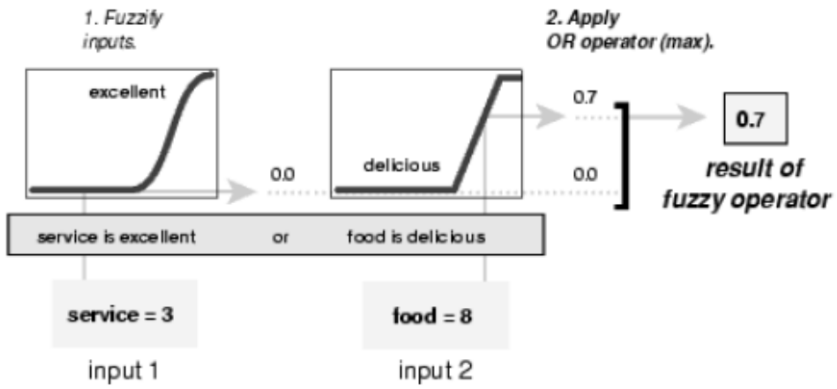


Fig 5.10 Implication (Dinner of two, example)

5.2.2.9. **Aggregation:** Since decisions are based on the testing of all of the rules in an FIS (fuzzy inference system), the rules must be combined in some manner in order to make a decision. Aggregation is the process by which the fuzzy sets that represent the outputs of each rule are combined into a single fuzzy set. Aggregation only occurs once for each output variable, just prior to the fifth and final step, defuzzification. The input of the aggregation process is the list of truncated output functions returned by the implication process for each rule. The output of the aggregation process is one fuzzy set for each output variable.

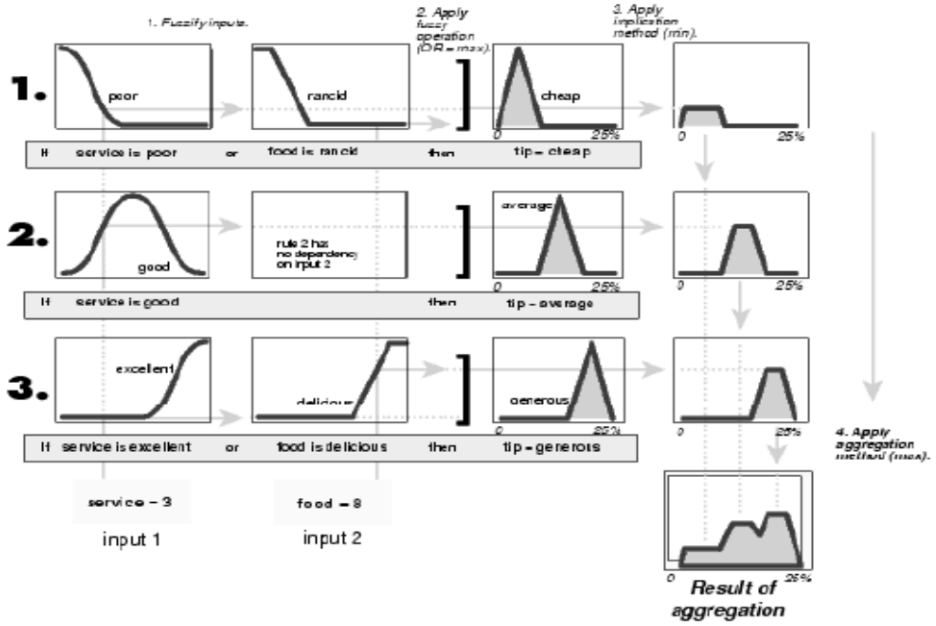


Fig 5.11 Aggregation (Dinner of two, example)

5.2.2.10. **Defuzzify:** The input for the defuzzification process is a fuzzy set (the aggregate output fuzzy set) and the output is a single number. As much as fuzziness helps the rule evaluation during the intermediate steps, the final desired output for each variable is generally a

single number. However, the aggregate of a fuzzy set encompasses a range of output values, and so must be defuzzified in order to resolve a single output value from the set. The most popular defuzzification method is the centroid calculation, which returns the center of area under the curve. There are other methods in practice: centroid, bisector, middle of maximum (the average of the maximum value of the output set), largest of maximum, and smallest of maximum.

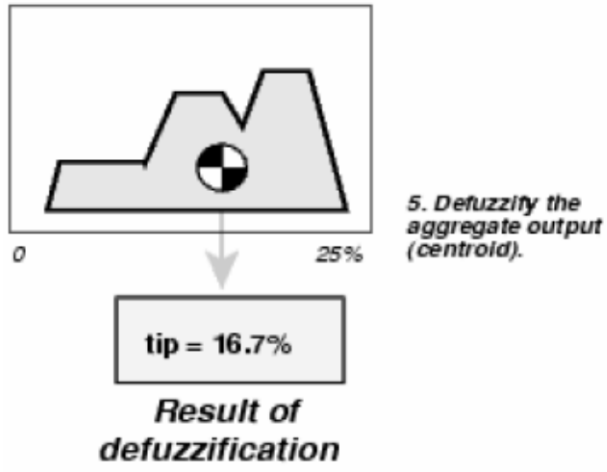


Figure: Defuzzification

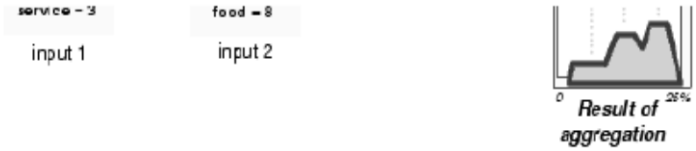


Fig 5.12 Deffuzification (Dinner of two, example)

During testing phase, a hypothetical crime example has been implemented. Results of testing are shown in chapter 6. Results of same test case, when applied in matlab (fuzzy system) are shown in fig 5.13.

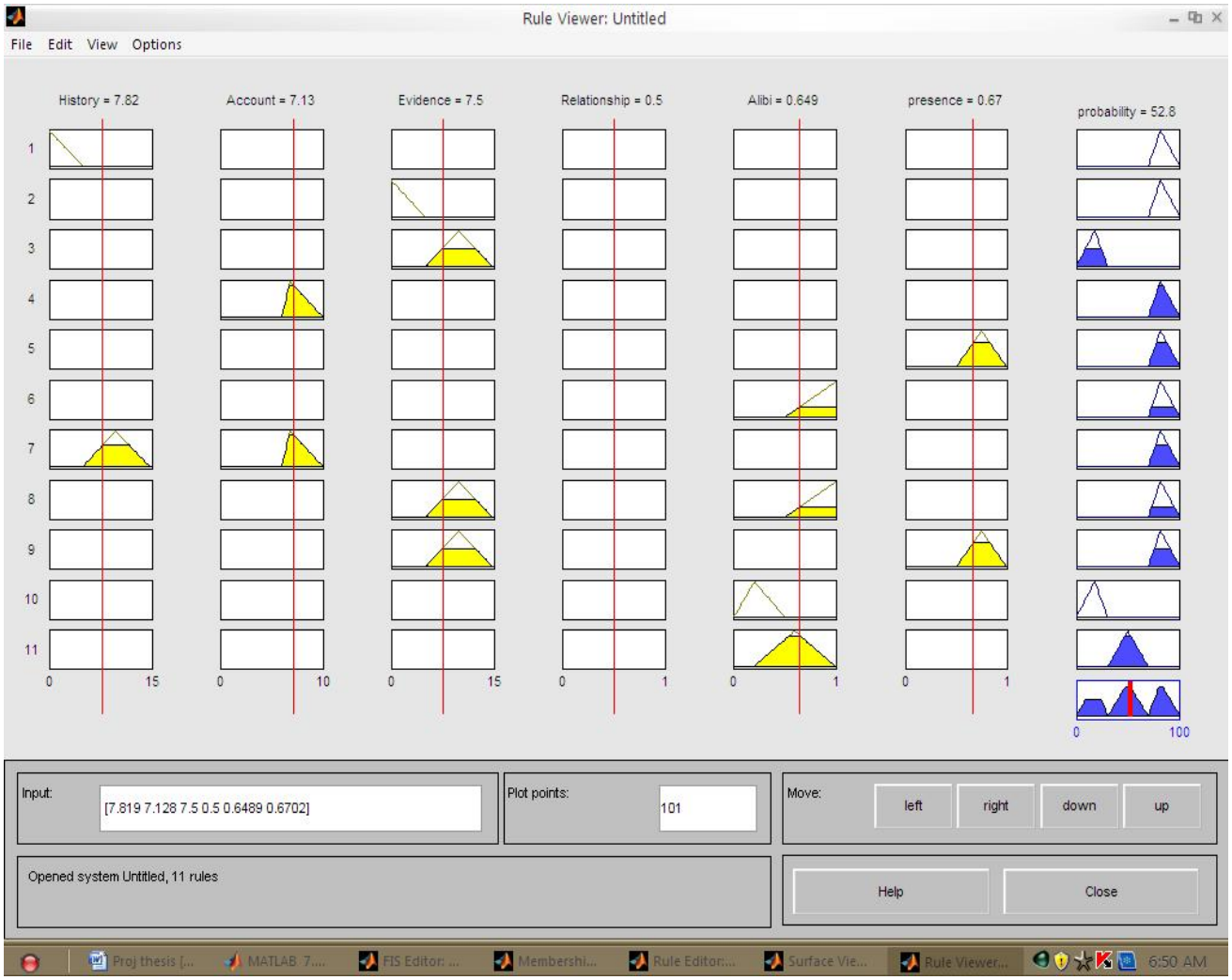


Fig 5.13 Implication and defuzzification (Theft example)

Interface available to investigator is simple, user friendly and easy to understand as shown in fig……..

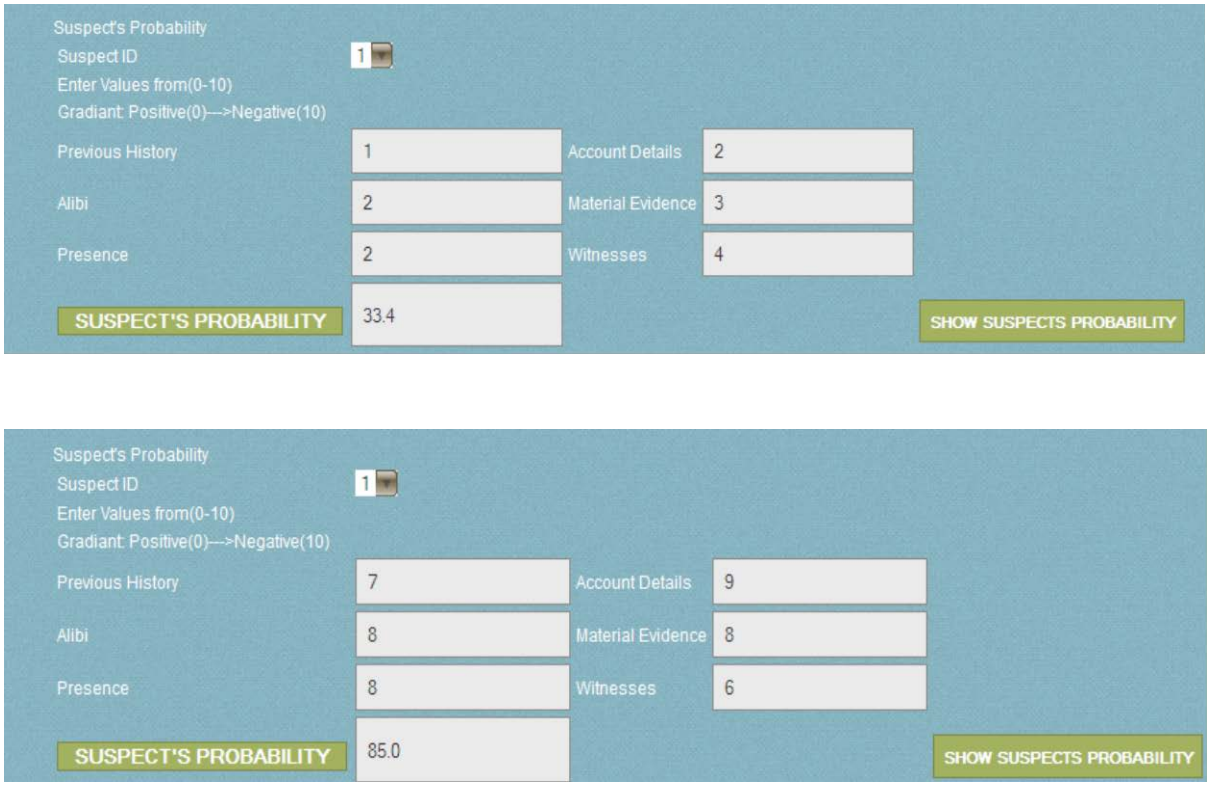


Fig 5.14 Interface to apply fuzzy logic in CDITS

5.2.3. **Viewer and Update Module:** Separate interfaces for viewer and update are provided as shown in fig 5.15

Fig 5.15 Update

5.2.4. **Database Development:** Database is developed using SQL server 2008. Normalization has been done to eradicate redundancy of data and implementing integrity constraints.

CHAPTER: 6

Testing & Result Analysis

6.1. **Testing of CDITS:** Testing is done during complete development of the project. Unit and Integration testing has been done during the development stage of the product. At the end of development a complete test of system is done against hypothetical crime scene.

6.1.1. **Unit Testing:** In unit testing, all the modules have been tested to make sure that they are all working efficiently without producing any kind of error. All the functionality of the software has been tested in this level of testing.

6.1.2. **Integration Testing:** In integration testing, integration of all the modules was tested and they were found fully integrated

6.1.3. **System Testing:** During system testing complete system was tested using hypothetical crime scene. Results of a theft are shown below.

BASIC DETAIL

TheftID	Nature	Place	Item_Stolen
2	Reported	Rawalpindi	5

VICTIM DETAILS

Name	CNIC	Designation	Address	Phone	Passport	DrivingLicence	Fax
Ali	37656587578	Bank Employe	H-No 4,Adyala Road, Rawalpindi	03225874658	545654658785	1233233	0515866585

SERVENTS DETAILS

Name	CNIC	Address	Phone
Ahmed	35658555475	Attok	03214445474

Name	CNIC	Address	Phone
Akbar	465554548487	Rawalpindi	03225548954

SUSPECT DETAILS

TheftID	SuspectID	Name	CNIC	Address	Designation	DrivingLicence	Fax	Passport	Phone
2	1	Asmat	85858587455	Westrage,Rawalpindi	student	14587587857	0514547858	725725872771	03124548769
2	2	Saad	85858587455	Lalazar,Rawalpindi	student	14587587857	0514547858	725725872771	03124548769
2	3	Usama	85858587455	Lalazar,Rawalpindi	student	14587587857	0514547858	725725872771	03124548769

WITNESS DETAILS

TheftID	WitnessID	Name	CNIC	Address	Designation	DrivingLicence	Fax	Passport	Phone
2	1	saqib	782572178527	Rawalpindi	civil Servent	785275272	7527411141	7527257527	0322585858

Fig 6.1 Basic Details of Incidence/Victim/Witnesses/Suspect

VICTIM STATMENT

heftID	VictimID	Statment
2	16	I left my room for work at around 1000hrs.When I came back my five precious items were stolen,which include a watch, television,computer,camera and refrigerator.

WITNESS STATMENT

TheftID	WitnessID	Statment
2	5	I saw three person breaking into house of victim.They had taken few items in a suzuki van.I immediately informed the police ,which came late,as always.

SUSPECT STATMENT

TheftID	SuspectID	Statment
2	1	I have not committed this crime,i went to college at 0800 hrs and came back at 1400hrs.
2	2	I have not committed this crime,i went to college at 0800 hrs and came back at 1400hrs.
2	3	I have not committed this crime,i went to college at 0800 hrs and came back at 1400hrs.

Fig 6.2 Statements of Victim/Witnesses/Suspect

INVESTIGATION HYPOTHESIS

TheftID	HypothesisID	Hypothesis
2	1	suspect 1,2,3 have committed the crime together
2	2	All three suspects are not criminals

SUSPECT'S PROBABILITY

TEST CASES

TheftID	HypothesisID	TestCaseID	TestCase
2	1	1	They must not have gone to the college
2	1	2	Witness must have seen anyone
2	1	3	Witness must have seen anyone
2	1	4	They must not be in college on theft day
2	2	5	Their alibi must be strong
2	2	6	Their alibi must be strong

TEST CASES VALIDATION

TheftID	HypothesisID	TestCaseID	ValidationID	Validation
2	1	1	1	They were not in college
2	1	2	2	witness can recognize suspect 1 and 2
2	2	5	3	No their alibi is weak

Fig 6.3 User defined Hypothesis

SHOW SUSPECTS PROBABILITY

TheftID	SuspectId	Probability
3	1	52.3
3	2	54.8
3	3	40.7

Fig 6.4 Suspect Probability (Calculated through Fuzzy System)

SHOW PROGRESS

Ser	TheftID	Date	Progress
1	2	May 16 2012 12:00AM	Alibi of three suspects checked,all three didnt go to college on that particular day
2	2	May 18 2012 12:00AM	Investigated witness, asking him specifically about three suspect,he could recognize two of them
3	2	May 20 2012 12:00AM	Interrogated three suspects,they did not accept the crime,but had contradiction in statments
4	2	May 23 2012 12:00AM	All three suspects accepted crime and were arrested

Fig 6.5 Daily Case Progresses


FINAL SUMMARY

TheftID	FinalSummary
2	Crime was committed by three students who are students of A private college,and resident of same place where victim is living.They accepted the crime.

Fig 6.6 Final Summary

CHAPTER: 7

Future Work & Conclusion

7.1. **Future Work:** CDITS is intended to be a nationwide Network of crime detection, investigation and tracking. The big picture (fig 1.3) clearly shows the huge scope of the project.

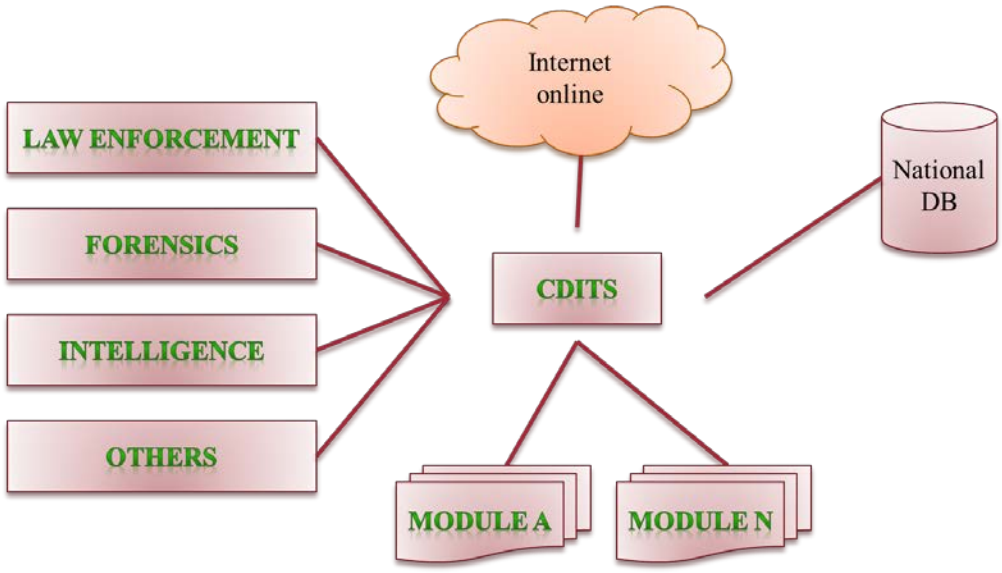


Figure 1.3: Big Picture

Following are the major works that need s to be done in this sector:

7.1.1. Improvements in current project through exhaustive testing and amendments in practical environment.

7.1.2. Incorporating Digital image processing module for detection and tracking of criminals throughout the country.

7.1.3. Network Security

7.1.4. Deployment of System

7.1.5. Incorporating the data providers in the system more efficiently

7.2. **Conclusion:** The crime prevention is foremost in a healthy progressive society however, where it cannot be fully implemented the short fall can be compensated through strong detection and investigation system to assist the process of justice. Automation of detection and tracking to facilitate speedy and fair investigations will help both the law enforcement agencies and judiciary to render speedy justice which is to a major part attributed to the paper based manual systems in vogue. These paper based proceedings are prone to malafiedy and tempering(s) with possible ulterior motives of the investigation agencies and their employees. This system will minimize and with furtherance will attain elimination of manual processes gradually and progressively by centralizing investigations and harmonizing tracking of criminals

Appendix A: Glossary

XVIII. **CDITS:** Criminal Detection Investigation and Tracking System

XIX. **Detection:** Refers to recognition of the actor (suspect(s)) depending upon the crime scene evidences, witnesses, leads formed by user defined hypothesis

XX. **Investigation:** Parsing the investigation process in a progressive, systematic, procedural and automated mode

XXI. **Tracking:** Tracking of investigative process, progressive acquisition of different related details and their inter relationships

XXII. **FIA:** Federal Investigation Agency

XXIII. **SIB**: Special Investigation Bureau

XXIV. **IB:** Intelligence bureau

XXV. **ISI**: Inter Services Intelligence

XXVI. **MI:** Military Intelligence

XXVII. **CID:** Crime Investigation Department

XXVIII.	**PTA:**	Pakistan Telecommunication Department
XXIX.	**LEAs:**	Law Enforcement Agencies
XXX.	**DB:**	Data Base
XXXI.	**MIS:**	Management Information System
XXXII.	**Cfm:**	Confirm
XXXIII.	**TBD:**	To be determined

Appendix B: References

1. *www.**criminology**.com/*
2. *www.hec.gov.pk/InsideHEC/Divisions/.../595_**CRIMINOLOGY**.pdf*
3. *www.shere2000.co.uk/pdf/**investigate**.pdf*
4. *ifpo.org/articlebank/interviewing.pdf*
5. *www.ncjrs.gov/pdffiles1/nij/213030.pdf*
6. *www.austinlinks.com/**Fuzzy**/tutorial.html*
7. *www.csee.wvu.edu/classes/cpe521/presentations/**System**.pdf*
8. petro.tanrei.ca/fuzzylogic/index.html

9. *www.mathworks.com/help/toolbox/**fuzzy**/fp130.html*

10. *www.slideshare.net/.../**fuzzy-logic**-in-the-real-world-2326817*

11. Artificial Intelligence by Stuart Russell and Peter Norvig